Size or Age Compositions of Atlantic Cod, American Plaice, and Witch Flounder in the Landings of Canadian Otter Trawlers, Danish Seiners, or Long-Liners in the Northwest Atlantic Ocean

Terry D. Beacham

Department of Fisheries and Oceans
Fisheries Research Branch
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

November 1982

Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 1679

Canadian Manuscript Report of Fisheries and Aquatic Sciences

These reports contain scientific and technical information that represents an important contribution to existing knowledge but which for some reason may not be appropriate for primary scientific (i.e. *Journal*) publication. They differ from Technical Reports in terms of subject scope and potential audience: Manuscript Reports deal primarily with national or regional problems and distribution is generally restricted to institutions or individuals located in particular regions of Canada. No restriction is placed on subject matter and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries management, technology and development, ocean sciences, and aquatic environments relevant to Canada.

Manuscript Reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report will be abstracted by *Aquatic Sciences and Fisheries Abstracts* and will be indexed annually in the Department's index to scientific and technical publications.

Numbers 1-900 in this series were issued as Manuscript Reports (Biological Series) of the Biological Board of Canada, and subsequent to 1937 when the name of the Board was changed by Act of Parliament, as Manuscript Reports (Biological Series) of the Fisheries Research Board of Canada. Numbers 901-1425 were issued as Manuscript Reports of the Fisheries Research Board of Canada. Numbers 1426-1550 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Manuscript Reports. The current series name was changed with report number 1551.

Details on the availability of Manuscript Reports in hard copy may be obtained from the issuing establishment indicated on the front cover.

Rapport manuscrit canadien des sciences halieutiques et aquatiques

Ces rapports contiennent des renseignements scientifiques et techniques qui constituent une contribution importante aux connaissances actuelles mais qui, pour une raison ou pour une autre, ne semblent pas appropriés pour la publication dans un journal scientifique. Ils se distinguent des Rapports techniques par la portée du sujet et le lecteur visé; en effet, ils s'attachent principalement à des problèmes d'ordre national ou régional et la distribution en est généralement limitée aux organismes et aux personnes de régions particulières du Canada. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du Ministère des Pêches et des Océans, notamment gestion des pêches; techniques et développement, sciences océaniques et environnements aquatiques, au Canada.

Les Manuscrits peuvent être considérés comme des publications complètes. Le titre exact paraît au haut du résumé de chaque rapport, qui sera publié dans la revue *Aquatic Sciences and Fisheries Abstracts* et qui figuera dans l'index annuel des publications scientifiques et techniques du Ministère.

Les numéros de 1 à 900 de cette série ont été publiés à titre de manuscrits (Série biologique) de l'Office de biologie du Canada, et après le changement de la désignation de cet organisme par décret du Parlement, en 1937, ont été classés en tant que manuscrits (Série biologique) de l'Office des recherches sur les pêcheries du Canada. Les numéros allant de 901 à 1425 ont été publiés à titre de manuscrits de l'Office des recherches sur les pêcheries du Canada. Les numéros 1426 à 1550 ont été publiés à titre de Rapport manuscrits du Service des pêches et de la mer, Ministère des Pêches et de l'Environnement. Le nom de la série a été changé à partir du rapport numéro 1551.

La page couverture porte le nom de l'établissement auteur où l'on peut se procurer les rapports sous couverture cartonnée.

Canadian Manuscript Report of Fisheries
and Aquatic Sciences No. 1679

November 1982

SIZE OR AGE COMPOSITIONS OF ATLANTIC COD, AMERICAN PLAICE, AND WITCH FLOUNDER IN THE LANDINGS OF CANADIAN OTTER TRAWLERS, DANISH SEINERS, OR LONG-LINERS IN THE NORTHWEST ATLANTIC OCEAN

by

Terry D. Beacham

Department of Fisheries and Oceans
Fisheries Research Branch
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

(c) Minister of Supply and Services Canada 1982

Cat. No. Fs 97-4/1679 ISSN 0706-6473

ABSTRACT

Beacham, T. D. 1982. Size or age compositions of Atlantic cod, American plaice, and witch flounder in the landings of Canadian otter trawlers, Danish seiners, or long-liners in the Northwest Atlantic Ocean. Can. MS Rep. Fish. Aquat. Sci. No. 1679: iv + 73 p.

Size or age compositions of cod, American plaice, and witch flounder in the landings of Canadian otter trawlers, Danish seiners, or long- and hand-liners were investigated. Mean size and age of cod in the landings have generally declined through time, and cod in the landings of otter trawlers were younger and smaller than in the landings of line gear, but this trend was not consistent in samples derived from landings on the Scotian Shelf. Cod were younger in the landings of both gear types in southern areas as compared with northern ones, but southern cod were of similar size or larger than more northern cod. During 1975-1979, over 50% of the cod in the landings of otter trawls and line gear was below 60 cm in length. American plaice in the landings of otter trawlers were generally larger and older than those in the landings of Danish seiners. Males were smaller and younger than females in the landings of both gear types. Less than 10% of the landings were of plaice less than 30 cm in total length. Witch flounder in the landings of Danish and Scottish seiners were smaller than those in the landings of otter trawlers. Males were smaller than females in the landings of both gear types.

Key words: American plaice, cod, Danish seine, exploitation, fishery, handline, longline, otter trawl, witch flounder.

RÉSUMÉ

Beacham, T. D. 1982. Size or age compositions of Atlantic cod, American plaice, and witch flounder in the landings of Canadian otter trawlers, Danish seiners, or long-liners in the Northwest Atlantic Ocean. Can. MS Rep. Fish. Aquat. Sci. No. 1679: iv + 73 p.

Le présent rapport porte sur l'étude de la composition par âge et par taille de la morue, de la plie du Canada et de la plie grise dans les débarquements des chalutieurs, des bateaux de pêche à la senne danoise, des palangriers et des bateaux de pêche à la ligne à main. La longuer et l'âge moyens de la morue dans les débarquements ont en général baissé et les morues pêchées par les chalutiers étaient plus petites et plus jeunes que celles pêchées à la ligne. Cette tendance ne s'est toutefois pas maintenue dans les échantillons prélevés des débarquements provenant de la plate-forme Scotian. Les morues capturées à l'aide de ces deux engins dans les zones méridionales étaient plus jeunes que celles prises dans les zones septentrionales, mais les premières étaient de même taille ou plus grosses que les dernières. De 1975 à 1979, plus de 50% des morues capturées au chalut et à la ligne mesuraient moins de 60 cm de longueur. Les plies du Canada capturées par les chalutiers étaient en général plus grosses et plus vieilles que les prises des bateaux de pêche à la senne danoise. Les mâles étaient plus petits et plus jeunes que les femelles dans les débarquements de ces deux types de bateaux. Les plies d'une longueur totale inférieure à 30 cm constituaient moins de 10% des débarquements. Les plies grises capturées par les bateaux de pêche à la senne danoise et à la senne écossaise étaient plus petites que les prises des chalutiers. Les mâles étaient moins gros que les femelles dans les débarquements de ces deux types de bateaux.

Mots-clés: plie du Canada, morue, senne danoise, exploitation, pêcherie, ligne à main, palangre, chalutier, plie grise.

INTRODUCTION

Cod, American plaice, and witch flounder are widely distributed in the southern Gulf of St. Lawrence and on the Scotian Shelf, but only cod and plaice are generally abundant (Scott 1976). Cod has been exploited in the Maritimes area of Canada for hundreds of years, and it is currently the most valuable economically finfish species exploited in the Maritimes. Before about 1950, the fishery was largely conducted by long- and hand-lines (Paloheimo and Kohler 1968), but with the introduction of the otter trawl, the proportion of cod landings in the Maritimes region that is attributable to long- and hand-lines has declined considerably since 1950. Otter trawlers were the dominant gear type conducting the fishery in the 1970s. Research on the biology and pattern of exploitation of cod has been an area of continuing research (Paloheimo and Kohler 1968; Halliday 1974, 1976; Lett and Doubleday 1976; Beacham 1982), and is of importance in an investigation of the impact of commercial fisheries upon Atlantic cod. Development of the American plaice and witch flounder fisheries was concurrent with expansion of the otter trawl fleet. Selectivities of long- and hand-lines, Danish seiners, and otter trawls are usually different, and thus would be expected to catch different segments of a stock. The present report compares size or age compositions of cod, American plaice and witch flounder in the landings of Canadian otter trawlers, Danish seiners, or long- and hand-liners.

METHODS

Length and age compositions of the species investigated in samples from the commercial landings were determined for 5-yr groupings. The estimation of age compositions first required increasing the number sampled at each 3-cm length interval (cod) or 1-cm interval (plaice, witch) to the total catch of the sampled boat. Values from each sample were weighted by the ratio of catch weight of sampled boat to weight of sampled fish. Age-length keys were applied to the total length frequency to give age compositions. The age of the species was determined from otoliths according to the method of Kohler (1964). Fork length of cod and total length of plaice and witch were measured to the nearest cm in the commercial samples. Length compositions are presented by 3-cm intervals ranging from 24.0 - 26.9 cm, 27.0 - 29.9 cm, 30.0 - 32.9 cm etc.

RESULTS

COD

The analysis of landings of cod from the commercial fishery indicated that the mean age of cod landed in the 1970s was less than in the 1960s and 1950s for otter trawlers (Table 1) and long- and hand-liners (Table 2). Cod were sometimes younger and smaller in the landings of otter trawlers than those in landings of long- and hand-liners, but this trend was not universal, especially in samples derived from landings on the Scotian Shelf.

Modal age of cod in the landings of long- and hand-liners has generally declined through time. In Div. 4T, modal age of cod in the landings during the 1950s was 8 yr, declined to 6 yr during 1960-1964, and was 5 yr during 1975-1979 (Fig. 1). About 60% of the cod landed during 1975-1979 were less than 54 cm in length. In Subdiv. 4Vn during 1975-1979, modal age of cod in the long- and hand-line landings was again age 5, and about 60% were under 54 cm in length (Fig. 2). In Subdiv. 4Vs, no samples were available for line landings of cod in the 1960s or 1970s (Table 2). In the 1950s, cod age 8 and older comprised about 65% of the landings of the long-and hand-liners (Fig. 3). Mean age of cod in the line landings from Div. 4W declined almost 3 yr in age from the 1950s to 1975-1979 (Fig. 4). During 1975-1979, about 60% of the cod landed by line gear were age 5 or under, and about 65% were under 60 cm in length. In Div. 4X, modal age of cod in the line landings was 4 yr, and about 70% of cod in the landings were age 5 or less (Fig. 5). In Subdiv. 5Ze during 1975-1979, cod age 6 or younger comprised about 80% of the landings (Fig. 6).

Landings of cod from otter trawlers have been sampled more extensively than those from line gear. In Div. 4R in the 1970s, about 40% of the landings of trawlers were of cod under age 6, with cod in the 48- to 60-cm range comprising over 50% of the landings (Fig. 7). In Div. 4T in the 1970s, about 70% of the cod landed by otter trawlers were less than age 6, and 70% were less than 54 cm in length (Fig. 8). In Subdiv. 4Vn in the 1970s, over 60% of cod in the landings from January to April were less than age 6, and cod less than 54 cm comprised over 60% of the landings (Fig. 9). At least 65% of the cod in the landings of otter trawlers from May to December in Subdiv. 4Vn in the 1970s were age 6 or less, and cod between 42 and 60 cm in length comprised over 80% of the landings in the 1970s (Fig. 10). Samples from the trawler landings in Subdiv. 4Vs indicated that cod age 5 or younger comprised about 50% of the landings in the 1960s, and increased to about 60% during 1975-1979 (Fig. 11). In Div. 4W, there has been a marked reduction in the proportion of older cod in the landings, with about 75% of the landed cod age 5 or less during 1975-1979 (Fig. 12). Cod greater than 72 cm in length comprised less than 5% of the landings in Div. 4W in the 1970s, whereas they comprised about 25% of the landings in the 1950s. In

Div. 4X, cod age 5 and younger have constituted about 70% of the landings since 1965 (Fig. 13). Cod less than 60 cm in length comprised about 50% of the landings. In Subdiv. 5Ze, over 90% of the landings of cod in the 1970s have been comprised of individuals age 4 or less, and cod less than 60 cm in length have comprised at least 70% of the landings (Fig. 14).

AMERICAN PLAICE

The analysis of landings from the commercial fishery indicated that American plaice were generally smaller and younger in the landings of Danish and Scottish seiners than those in the landings of otter trawlers, and that the mean age and length of landed males were less than those of females (Tables 3, 4). However, these values do not take into account discards of small plaice, especially those under 30 cm in length, and discards in this size group may be substantial (Belzile, MS 1978).

American plaice landed by Danish and Scottish seiners in Div. 4T in the 1970s were mainly aged 7-12 yr (Fig. 15). About 80% of the males that were landed were aged 10 yr or younger, and about 60% of the landed females were 10 yr old or younger. Less than 5% of the plaice that were landed were less than 30 cm in total length (Fig. 16). Virtually no males over 45 cm in length were landed, but about 10% of the females that were landed were over 45 cm in length. For plaice landed by Danish and Scottish seiners in Subdiv. 4Vn from 1975-79, 50% of the landed males were age 10 or less, as were 50% of the females (Fig. 17). About 15% of the landed males were under 30 cm in length, but only about 50% of the females were. Less than 5% of the males were over 45 cm in length, but about 10% of the females that were landed were over 45 cm in length. For plaice landed in Subdiv. 4Vs from 1975-79, modal age in the landings was 11 yr for both males and females (Fig. 18). About 20% of the landed males were over 45 cm in total length, as were 45% of the females.

American plaice landed by Canadian otter trawlers have been sampled in Divs. 4T and 4V. In Div. 4T, plaice age 10 and under accounted for 60% of the landings of males and an average of 50% of the landings of females in the 1970s (Fig. 19). From 1975-79, about 11% of the males and 2% of the females that were landed in Div. 4T were under 30 cm in total length (Fig. 20). Less than 5% of the males were over 45 cm in length, but about 20% of the females were over 45 cm. In subdiv. 4Vn, male plaice age 10 and under accounted for less than 40% of the landings of males in the 1970s, and plaice of the same age accounted for less than 20% of the landings of females (Fig. 21). About 10-15% of the males landed were over 45 cm in length, but about 25-60% of the females were over 45 cm in length (Fig. 22). In Subdiv. 4Vs, plaice age 10 and under comprised about 60% of the landings of males in the 1970s, and about 40% of the landings of

females (Fig. 23). About 10-15% of the males landed were over 45 cm in length, but over 60% of the females landed were greater than 45 cm in length (Fig. 24).

WITCH FLOUNDER

The analysis of landings from the commercial fishery indicated that witch flounder were generally small in the landings of Danish seiners than in the landings of otter trawlers (Tables 5, 6). For the landings of Danish seiners, the two samples from 1975-1979 available from Div. 4T indicated that most witch landed were between 33-42 cm in total length (Fig. 25). Witch in the landings of Danish seiners in Subdiv. 4Vn in the 1970s were between 33-45 cm in total length (Fig. 26). Witch in the landings of Danish seiners in Div. 4W had similar size distributions (Fig. 27) compared with witch in Subdiv. 4Vn. Females tended to be larger than males in all areas (Tables 5, 6).

Length frequencies of witch are presented in detail for only females in the otter trawl landings, as males had trends through time similar to those of females. In Div. 4T, the proportion of female witch over 54 cm in total length declined in the 1960s and 1970s relative to the 1950s (Fig. 28). For example, over 50% of the landed females were greater than 54 cm in length in the period from 1948-59, but less than 10% were greater than 54 cm in the 1970s. In Subdiv. 4Vn in the 1960s, about 15% of the females in the landings of Canadian otter trawlers were greater than 54 cm in length, but about only 5% were greater in the 1970s (Fig. 29). In Subdiv. 4Vs, about 90% of the females were between 39 and 54 cm in length in landings in the 1970s (Fig. 30). About only 5% were greater than 54 cm in length. Mean length of females landed in Div. 4W has changed little over the interval surveyed (Table 5), and this is indicted in the relative constancy of the length frequencies (Fig. 31). Less than 5% of the females landed in the 1970s were above 54 cm in length.

DISCUSSION

The results of the present report may be summarized as:

1. Mean size and age of cod in the landings of Canadian otter trawlers were generally lower in the 1970s than in the 1960s or 1950s.

2. There was some tendency for cod in the landings of otter trawlers to be younger and smaller than in the landings of

long- and hand-liners, but this trend was not consistent for samples from the Scotian Shelf.

3. Mean age of cod in the landings of both gear types tended to be less in more southern areas as compared with northern ones, but mean length was not smaller for cod in southern areas.

4. During 1975-1979, over 50% of the cod have generally been below 60 cm in length in the landings of otter trawlers and line gear.

5. American plaice in the landings of otter trawlers tended to be larger and older than those in the landings of Danish seiners.

6. Male plaice are younger and smaller than females in the landings of both gear types.

7. Less than 10% of the landings were of plaice less than 30 cm in total length.

8. Size and age compositions of plaice in the landings in this report do not take into account plaice that have been discarded before the catch is landed. If discards were included, mean length and age of plaice in the catch would probably be considerably less than those in the landings.

9. Witch in the landings of Danish and Scottish seiners were smaller than those in the landings of otter trawlers for both males and females.

10. Male witch are smaller than females in the landings of both types of gear.

ACKNOWLEDGEMENTS

I am indebted to those people who have sampled the landings in the commercial fishery for over 30 yr. Bev Charlton assisted in much of the analysis. The manuscript was prepared with the assistance of the staff at the Pacific Biological Station.

REFERENCES

Beacham, T. D. 1982. Some aspects of growth, Canadian exploitation, and stock identification of Atlantic cod (Gadus morhua) on the Scotian Shelf and Georges Bank in the Northwest Atlantic Ocean. Can. Tech. Rep. Fish. Aquat. Sci. 1069: 43 p.

Belzile, L. MS 1978. Report on the discarding of fish in the Canadian offshore fishery in ICNAF Subareas 4 and 5. Int. Comm. Northw. Atl. Fish. Res. Doc. 78/83, 12 p.

Halliday, R. G. 1974. The cod stocks of the southern Gulf of St. Lawrence and Sydney Bight (ICNAF Div. 4T-4Vn). Int. Comm. Northw. Atl. Fish. Res. Doc. 74/24: 16 p.

1976. Eastern Scotian Shelf cod: a reconstruction of possible events in the fishery in 1958 to 1974 and a re-estimation of potential yield. Int. Comm. Northw. Atl. Fish. Sel. Pap. 1: 7-18.

Kohler, A. C. 1964. Variations in the growth of Atlantic cod (Gadus morhua L.) J. Fish. Res. Board Can. 21: 57-100.

Lett, P. F., and W. G. Doubleday. 1976. The influence of fluctuations in recruitment on fisheries management strategy with special reference to the southern Gulf of St. Lawrence cod. Int. Comm. Northw. Atl. Fish. Sel. Pap. 1: 171-193.

Paloheimo, J. E., and A. C. Kohler. 1968. Analyses of the southern Gulf of St. Lawrence cod population. J. Fish. Res. Board Can. 25: 555-578.

Scott, J. S. 1976. Summer distribution of groundfish on the Scotian Shelf, 1970-74. Fish. Mar. Serv. Res. Dev. Tech. Rep. 635: 51 p.

Table 1. Mean length (cm), mean age (yr), and sample sizes of cod derived from sampling landings of Canadian otter trawlers, by Maritimes-based samplers, 1948-1979.

		Period				
	Area	1948-1959	1960-1964	1965-1969	1970-1974	1975-1979
Mean length	4R	-	62.2	58.3	55.9	54.4
	4T	63.4	51.9	47.0	45.5	50.3
	4Vna	60.6	52.0	51.7	52.0	50.5
	4Vnb	-	53.8	53.8	50.5	51.9
	4Vs	57.2	54.7	52.5	57.4	56.6
	4W	65.8	58.4	57.4	52.6	54.1
	4X	90.1	63.5	59.2	55.0	61.3
	5Ze	-	64.9	64.5	47.8	55.7
Mean age	4R	-	7.5	6.2	6.9	6.3
	4T	7.2	6.1	4.9	4.9	5.3
	4Vna	6.5	6.7	6.2	6.0	5.4
	4Vnb	-	6.8	6.0	5.0	4.9
	4Vs	6.3	5.7	5.7	6.2	5.5
	4W	7.3	5.7	5.4	4.9	5.1
	4X	8.8	5.4	4.7	3.9	4.4
	5Ze	-	5.0	5.0	3.4	3.1
Number of samples	4R	0	9	10	15	42
	4T	144	89	92	48	83
	4Vna	1	4	12	37	59
	4Vnb	0	2	5	4	6
	4Vs	32	4	8	18	41
	4W	60	18	24	23	39
	4X	1	3	46	28	35
	5Ze	0	4	18	2	53
Number measured	4R	0	3,321	3,272	5,025	12,301
	4T	30,288	38,738	26,588	11,517	18,453
	4Vna	441	1,800	4,260	11,726	19,241
	4Vnb	0	881	1,866	1,305	1,400
	4Vs	9,608	1,400	2,781	5,515	12,424
	4W	18,868	6,054	8,540	7,446	12,549
	4X	33	740	13,673	6,167	9,114
	5Ze	0	1,468	5,394	548	14,829
Number ages	4R	0	516	338	746	2,082
	4T	5,831	3,846	3,745	1,813	3,090
	4Vna	90	251	737	1,747	2,738
	4Vnb	0	133	187	162	234
	4Vs	1,927	236	463	890	2,018
	4W	3,642	1,367	1,444	998	1,766
	4X	33	356	2,774	1,239	1,765
	5Ze	0	458	1,155	115	2,543

[a]January to April landings only.
[b]May to December landings only.

Table 2. Mean length (cm), mean age (yr), and sample sizes of cod from sampling landings of Canadian long- and hand-liners, 1948-1979.

	Area	1948-1959	1960-1964	1965-1969	1970-1975	1975-1979
Mean length (cm)	4T	73.3	60.9	-	65.7	53.7
	4Vn	61.4	59.1	61.1	57.2	60.4
	4Vs	65.9	-	-	-	-
	4W	72.1	56.1	62.4	56.3	57.1
	4X	60.9	65.0	64.3	65.1	61.7
	5Ze	-	-	-	73.8	82.0
Mean age (yr)	4T	8.8	6.7	-	7.6	5.6
	4Vn	7.0	6.6	6.7	6.5	6.3
	4Vs	8.4	-	-	-	-
	4W	7.9	7.8	6.6	5.3	5.2
	4X	4.7	5.8	6.1	5.1	4.8
	5Ze	-	-	-	5.2	6.2
Number of samples	4T	50	16	0	5	46
	4Vn	56	14	21	15	17
	4Vs	6	0	0	0	0
	4W	41	1	6	5	28
	4X	150	16	2	16	36
	5Ze	0	0	0	3	1
Number measured	4T	3,493	4,329	0	919	9,059
	4Vn	17,005	3,793	6,749	4,691	4,366
	4Vs	2,400	0	0	0	0
	4W	11,716	133	1,812	1,273	7,440
	4X	25,658	4,366	452	2,959	9,072
	5Ze	0	0	0	516	69
Number aged	4T	2,410	701	0	118	1,765
	4Vn	3,404	809	1,164	779	823
	4Vs	480	0	0	0	0
	4W	2,482	46	281	219	1,289
	4X	5,409	1,073	131	821	2,134
	5Ze	0	0	0	138	36

Table 3. Mean length (cm), mean age (yr), and sample sizes of American plaice derived from sampling landings of Canadian otter trawlers, 1965-1979.

	Area	Sex	Period		
			1965-1969	1970-1974	1975-1979
Mean length (cm)	4T	Male	33.9	33.3	34.7
		Female	35.3	39.2	40.9
	4Vn	Male	-	39.1	37.5
		Female	-	49.0	42.9
	4Vs	Male	38.1	37.7	36.6
		Female	49.5	46.1	43.4
Mean age (yr)	4T	Male	-	8.8	10.0
		Female	-	9.9	11.9
	4Vn	Male	-	11.6	11.2
		Female	-	13.7	12.5
	4Vs	Male	8.4	9.8	9.9
		Female	12.4	12.2	11.6
Number of samples	4T		9	6	30
	4Vn		2	5	6
	4Vs		5	16	44
Number measured	4T		1,361	1,202	5,916
	4Vn		307	900	1,135
	4Vs		881	3,091	8,727
Number aged	4T		0	209	1,144
	4Vn		34	234	266
	4Vs		109	631	1,877

Table 4. Mean length (cm), mean age (yr), and sample sizes of American plaice from sampling landings of Canadian Danish and Scottish seiners, 1970-1979.

	Area	Sex	1970-1974	1975-1979
Mean length (cm)	4T	M	32.1	32.6
		F	38.8	36.8
	4Vn	M	-	34.2
		F	-	37.5
	4Vs	M	-	40.7
		F	-	45.9
Mean age (yr)	4T	M	8.6	9.0
		F	10.6	9.6
	4Vn	M	-	10.5
		F	-	11.0
	4Vs	M	-	11.4
		F	-	12.8
Number of samples	4T		6	78
	4Vn		0	34
	4Vs		0	3
Number measured	4T		1,202	15,617
	4Vn		0	6,719
	4Vs		0	564
Number aged	4T		205	2,690
	4Vn		0	1,251
	4Vs		0	131

Table 5. Mean length (cm) and sample sizes of witch flounder from sampling landings of Canadian otter trawlers, 1948-1979.

	Area	Sex	1948-1959	1960-1964	1965-1969	1970-1974	1975-1979
Mean length (cm)	4T	M	45.9	37.5	41.7	41.5	41.7
		F	52.5	42.8	48.1	43.1	45.4
	4Vn	M	45.2	41.0	41.1	42.0	39.4
		F	47.9	48.5	48.2	47.9	44.5
	4Vs	M	-	-	43.3	40.7	40.5
		F	-	-	43.3	47.9	46.5
	4W	M	43.3	39.8	41.0	40.3	42.8
		F	46.4	44.4	47.3	45.3	47.0
Number of samples	4T		14	10	2	1	5
	4Vn		8	6	7	6	11
	4Vs		0	0	8	11	17
	4W		15	3	3	4	6
Number measured	4T		1383	1374	310	214	985
	4Vn		950	1352	1444	1200	2673
	4Vs		0	0	1550	2026	3385
	4W		1300	484	503	858	1181

Table 6. Mean length (cm) and sample sizes of witch flounder from sampling landings of Canadian Danish and Scottish seiners, 1960-1979.

	Area	Sex	1960-1964	1965-1969	1970-1974	1975-1979
Mean length (cm)	4T	M	45.5	41.1	42.7	37.9
		F	54.5	48.8	46.1	40.5
	4Vn	M	37.4	39.3	36.7	37.6
		F	41.9	42.9	40.7	41.3
	4W	M	40.7	41.6	42.0	40.9
		F	46.9	45.2	46.0	43.8
Number of samples	4T		1	1	1	2
	4Vn		2	5	1	35
	4W		3	6	6	4
Number measured	4T		153	200	200	400
	4Vn		400	1000	200	7257
	4W		453	943	1112	800

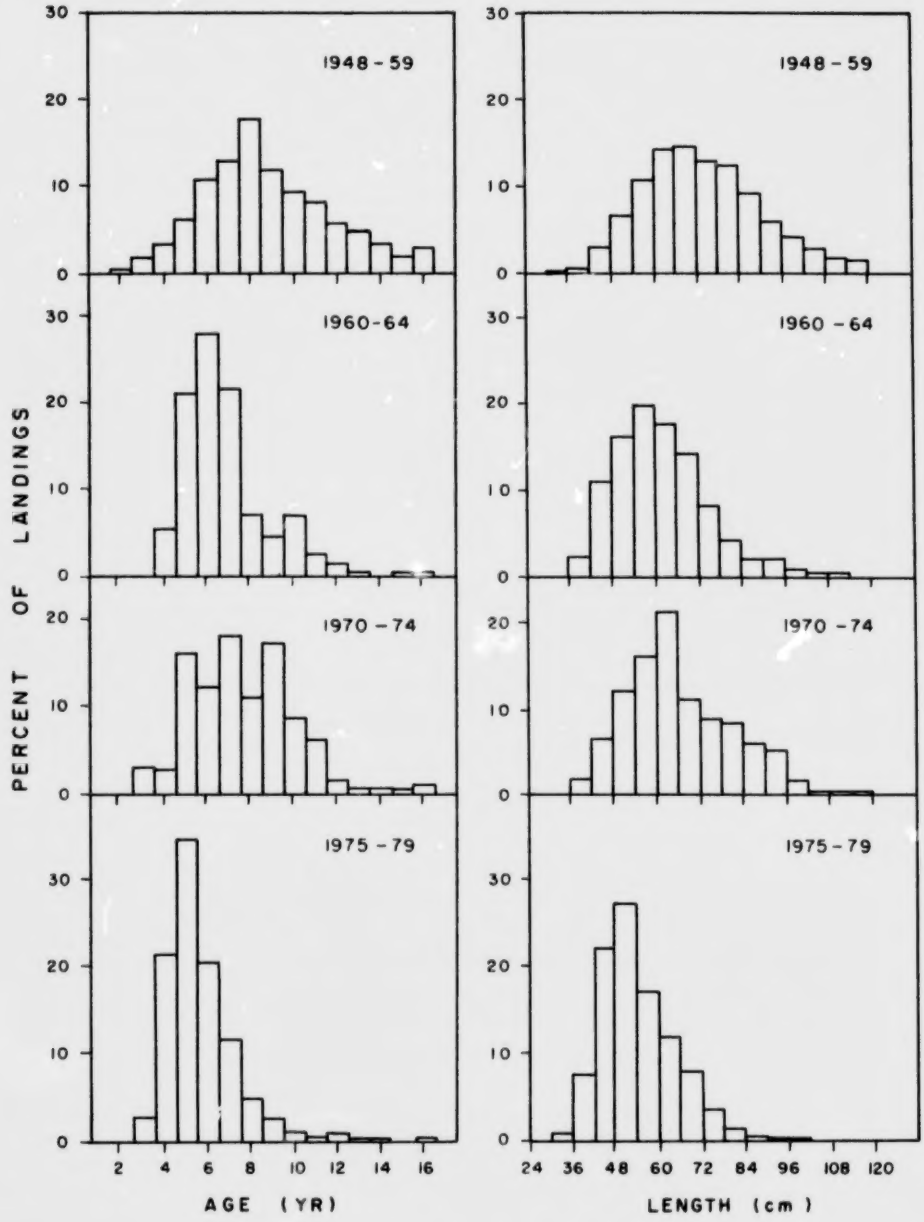

Fig. 1. Age compositions and length frequencies of cod landed by Canadian longliners from Div. 4T, 1948-79.

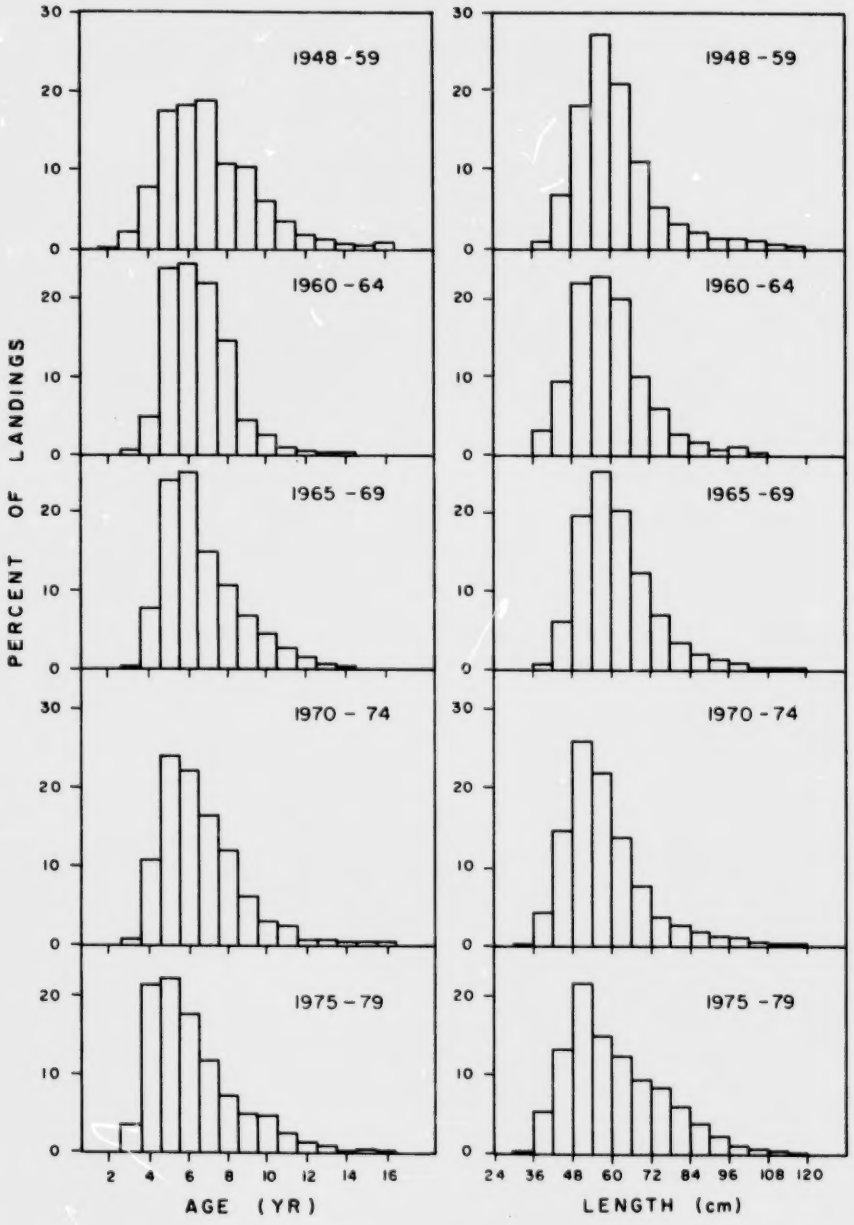

Fig. 2. Age compositions and length frequencies of cod landed by Canadian longliners from Subdiv. 4Vn, 1948-79.

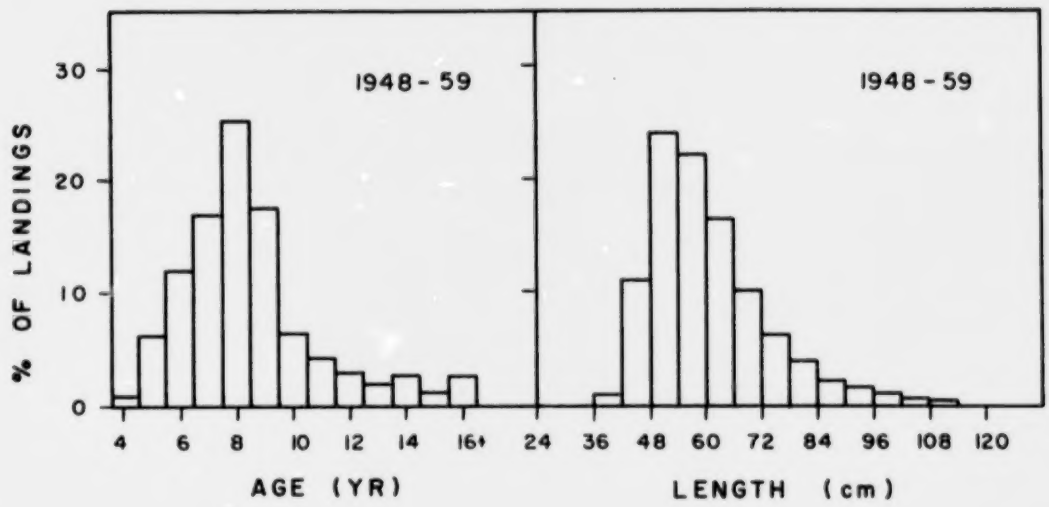

Fig. 3. Age compositions and length frequencies of cod landed by Canadian longliners from Subdiv. 4Vs, 1948-59.

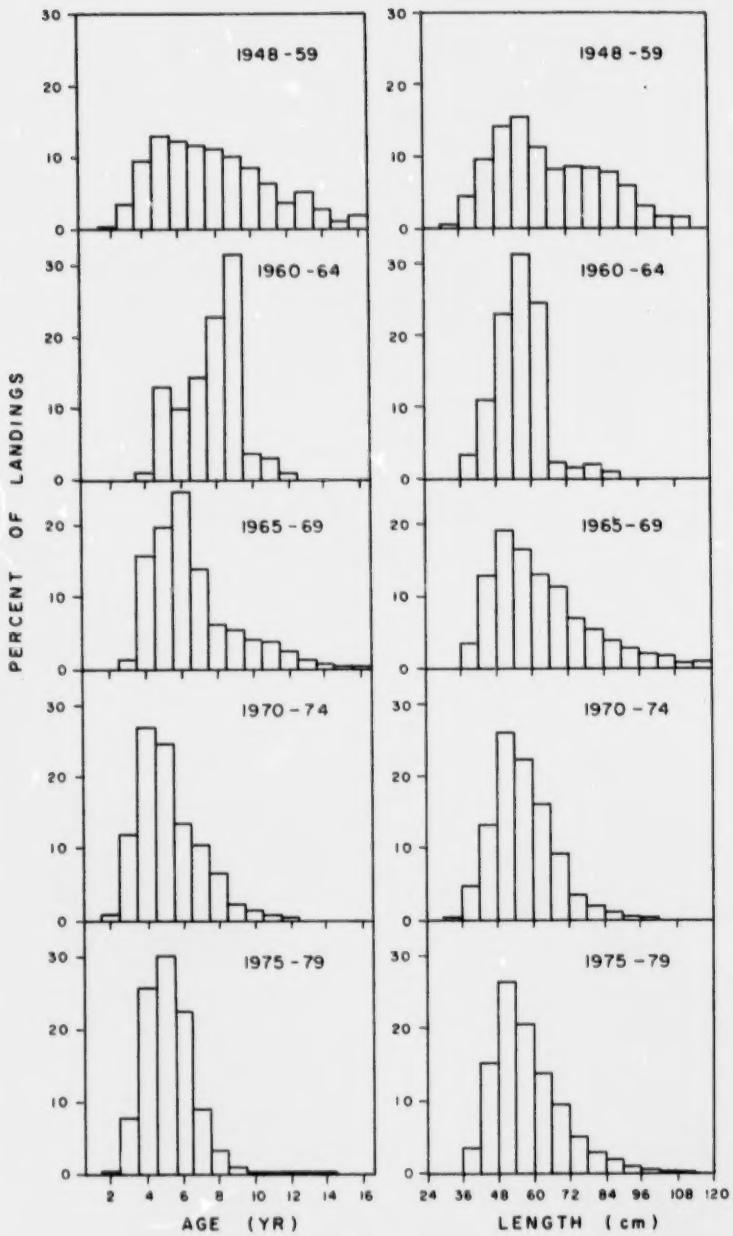

Fig. 4. Age compositions and length frequencies of cod landed by Canadian longliners in Div. 4W, 1948-79.

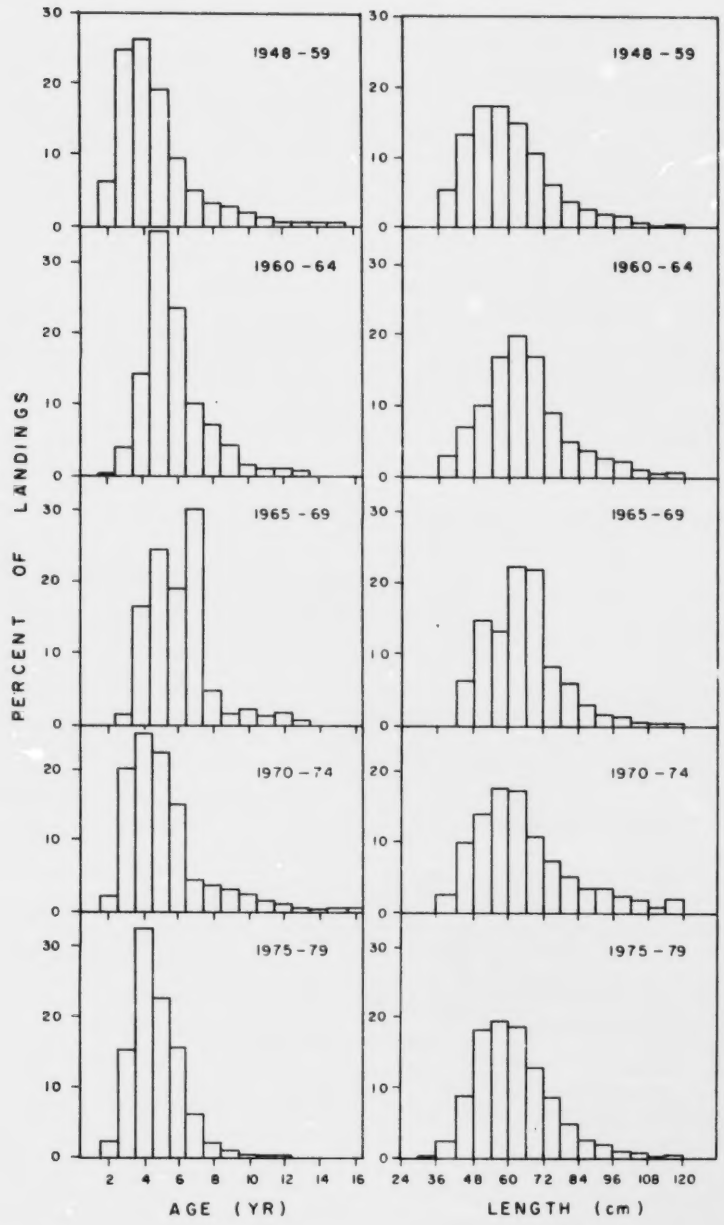

Fig. 5. Age compositions and length frequencies of cod landed by Canadian longliners from Div. 4X, 1948-79.

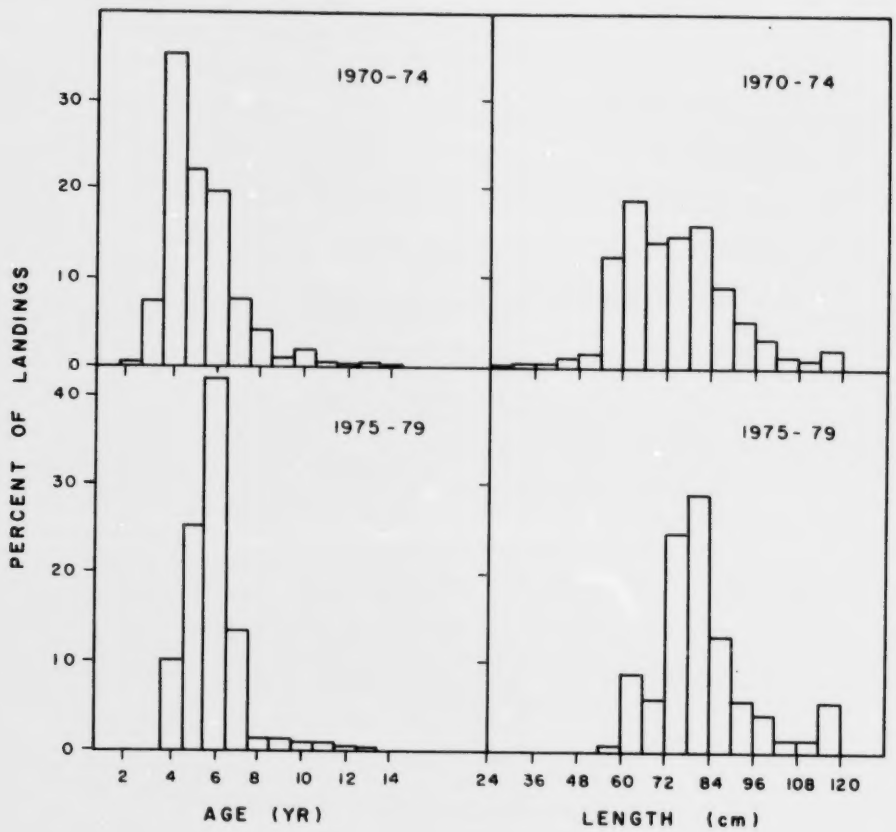

Fig. 6. Age compositions and length frequencies of cod landed by Canadian longliners from Subdiv. 5Ze, 1970-79.

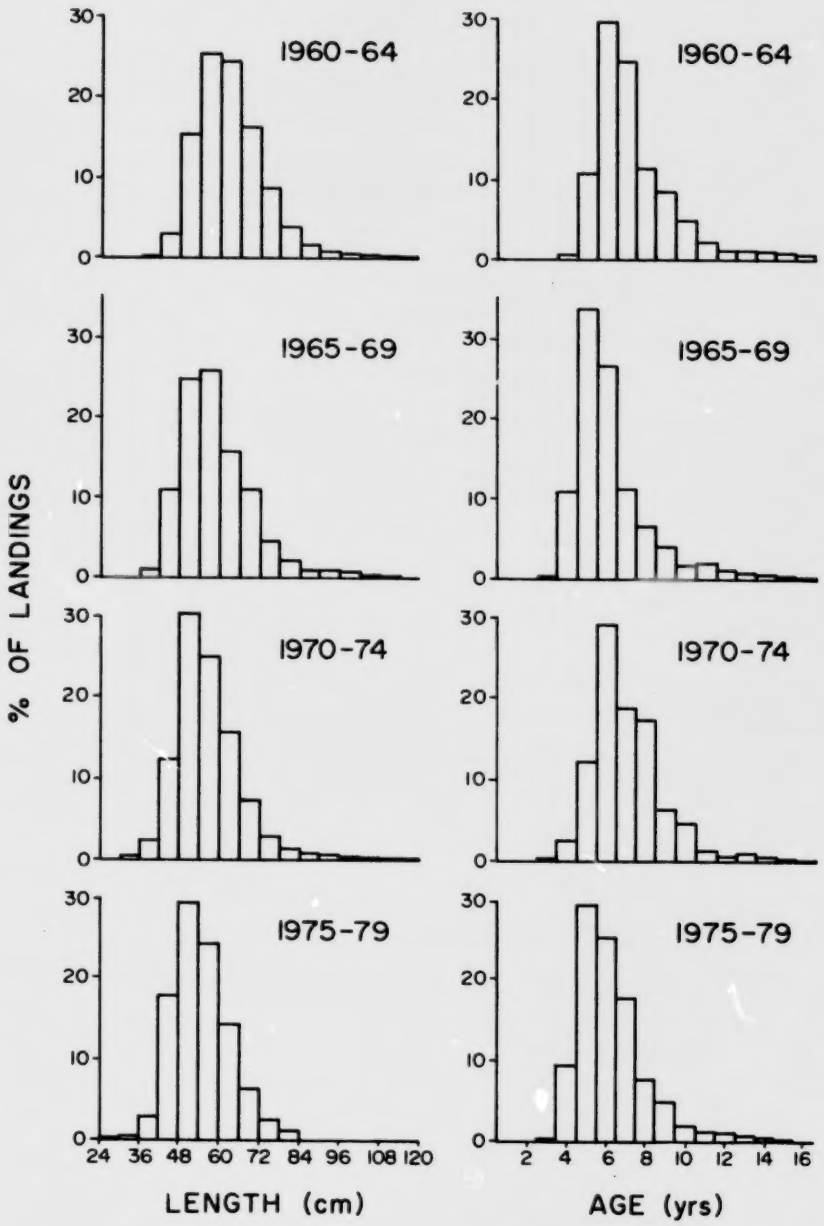

Fig. 7. Length frequencies and age distributions for cod landed by Canadian otter trawlers in Div. 4R, as sampled by Maritimes-based samplers, 1960-79.

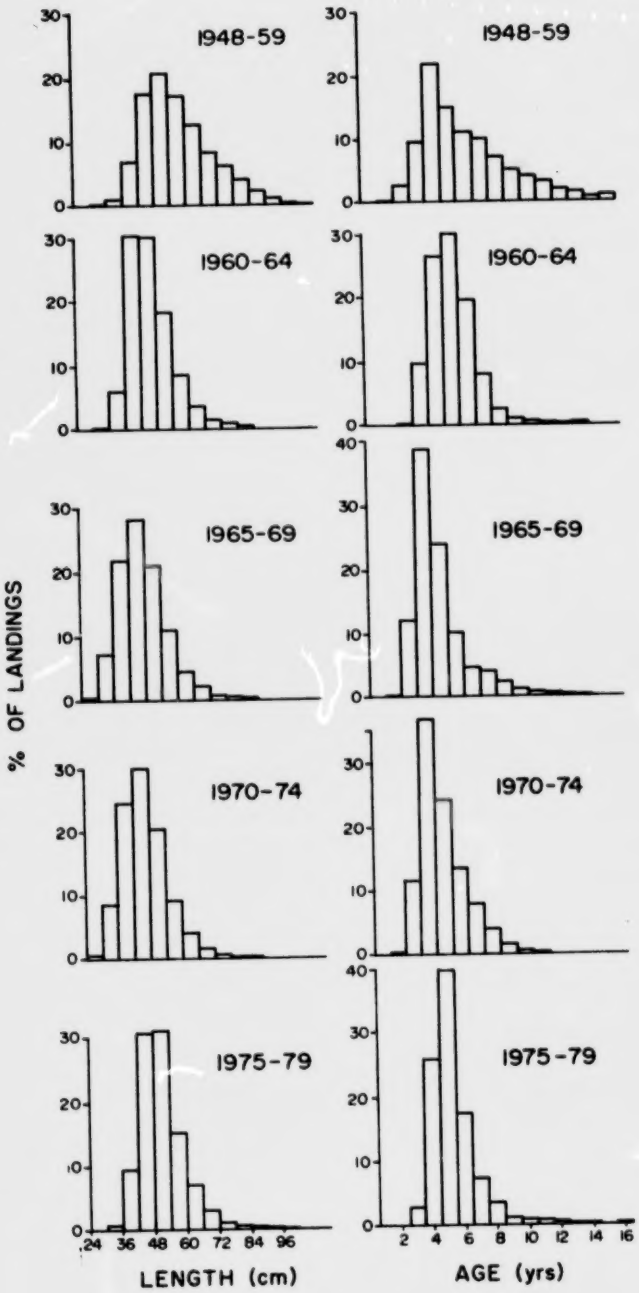

Fig. 8. Length frequencies and age compositions for cod landed by Canadian otter trawlers in Div. 4T, 1948-79.

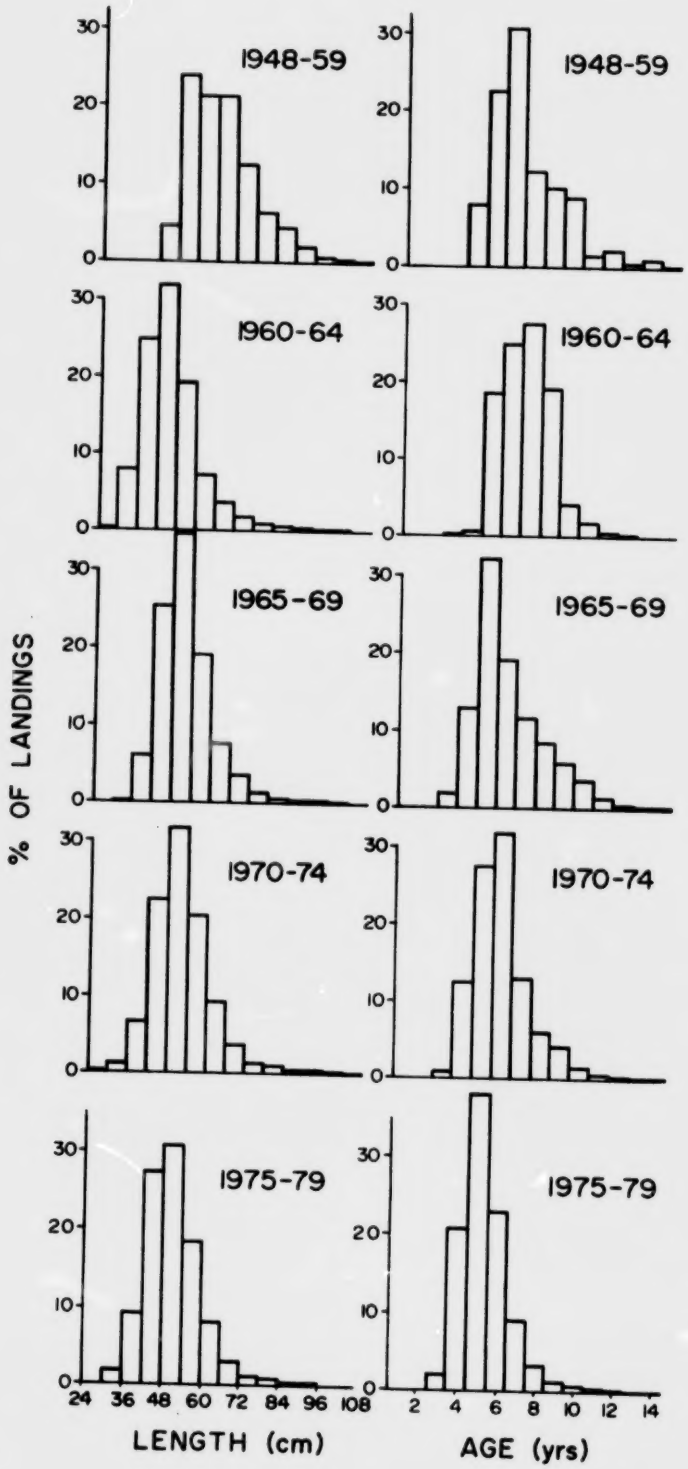

Fig. 9. Length frequencies and age composition for cod landed by Canadian otter trawlers during January-April in Subdiv. 4Vn, 1948-79.

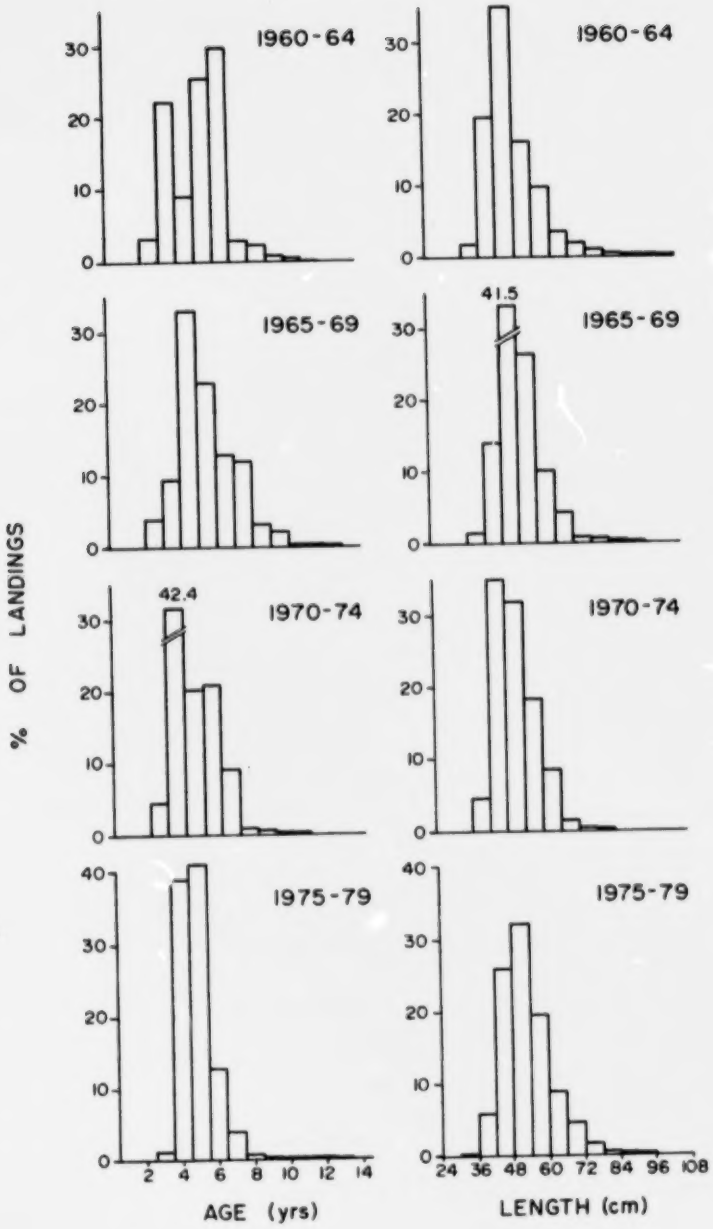

Fig. 10. Age compositions and length frequencies of cod landed by Canadian otter trawlers in Subdiv. 4Vn from May-December, 1960-79.

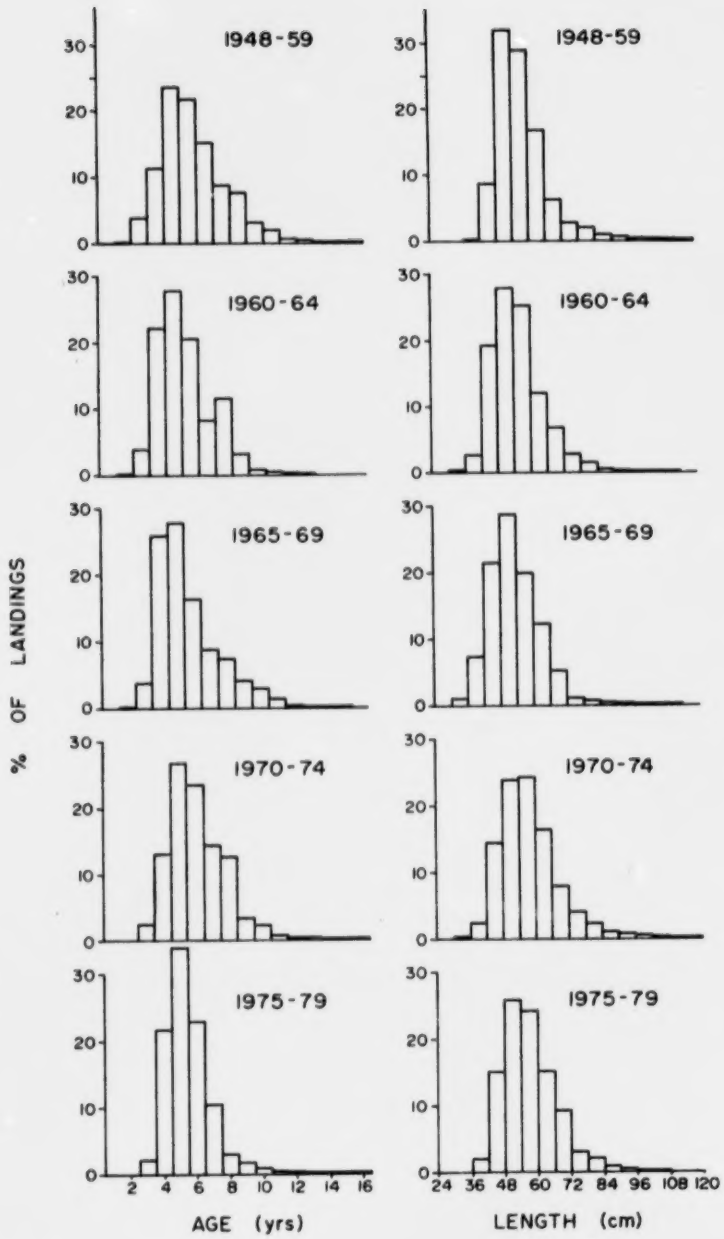

Fig. 11. Age compositions and length frequencies for cod landed by Canadian otter trawlers in Subdiv. 4Vs, 1948-79.

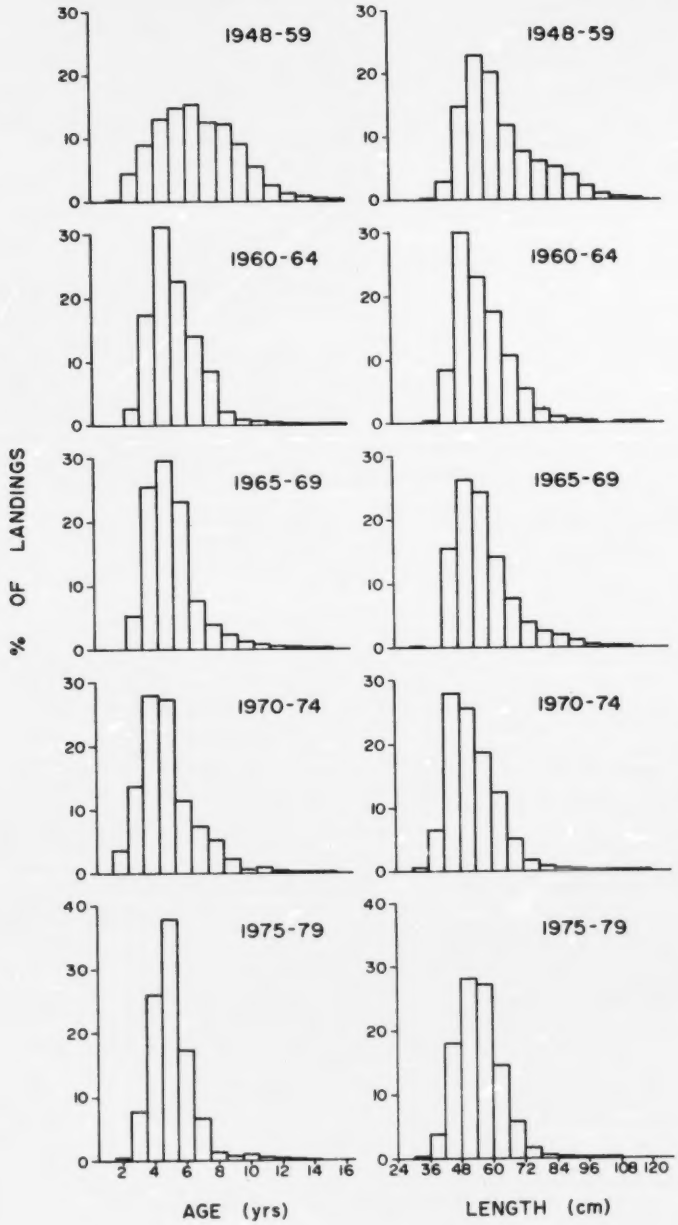

Fig. 12. Age compositions and length frequencies for cod landed by Canadian otter trawlers in Div. 4W, 1948-79.

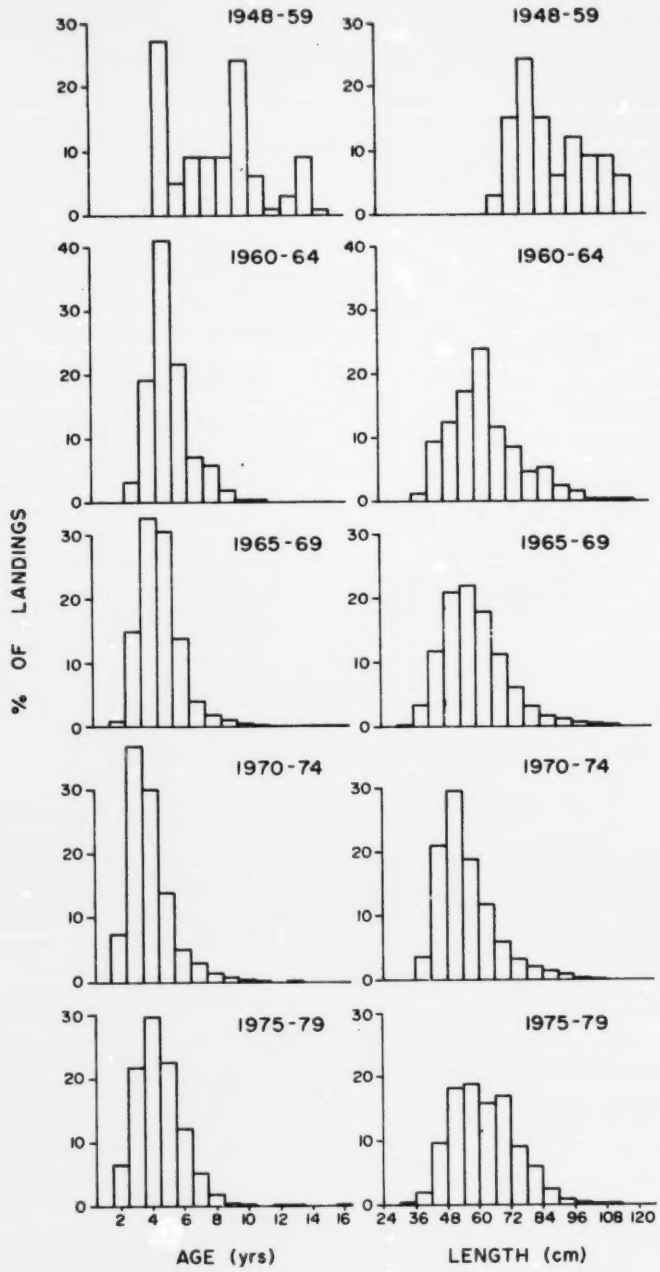

Fig. 13. Age compositions and length frequencies for cod landed by Canadian otter trawlers in Div. 4X, 1948-79.

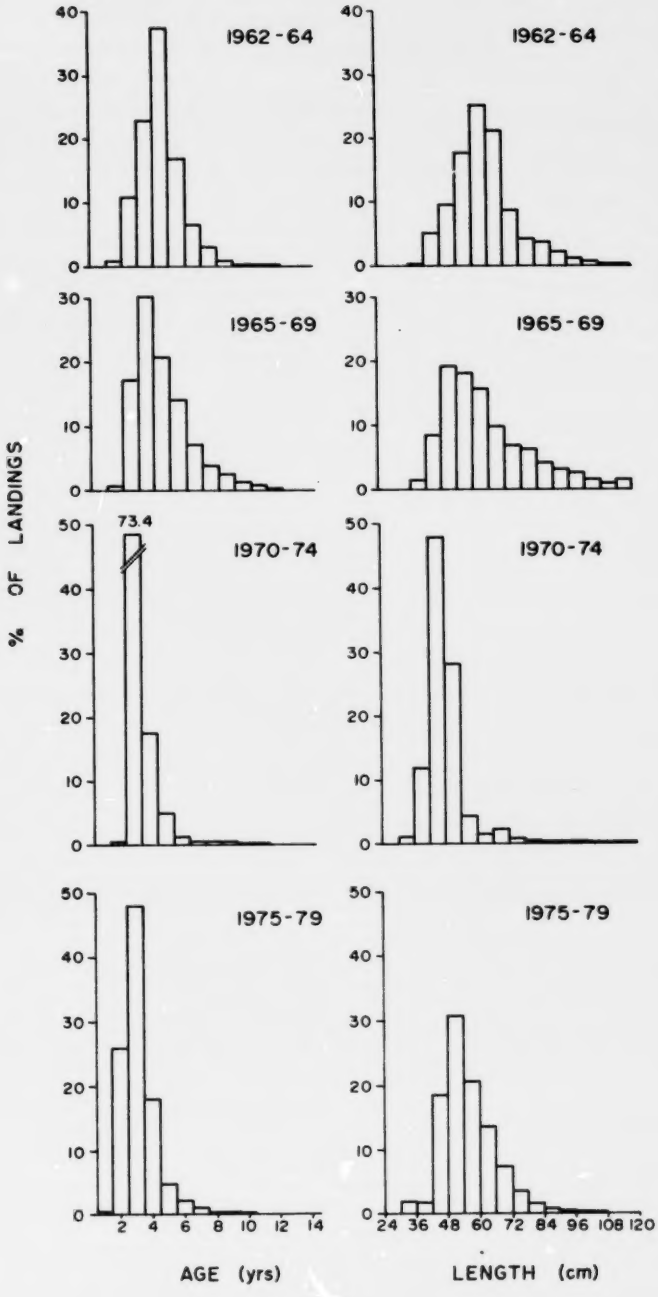

Fig. 14. Age compositions and length frequencies for cod landed by Canadian otter trawlers in Subdiv. 5Ze, 1962-79.

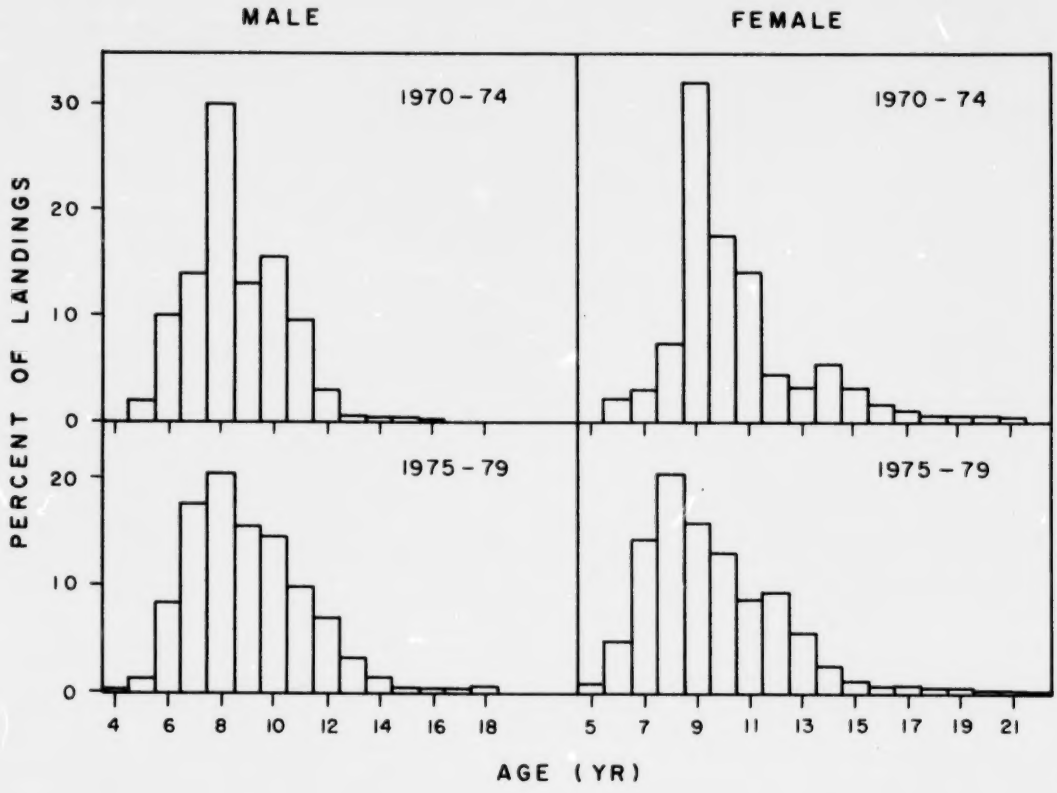

Fig. 15. Age compositions of American plaice landed by Canadian Danish seiners in Div. 4T, 1970-79.

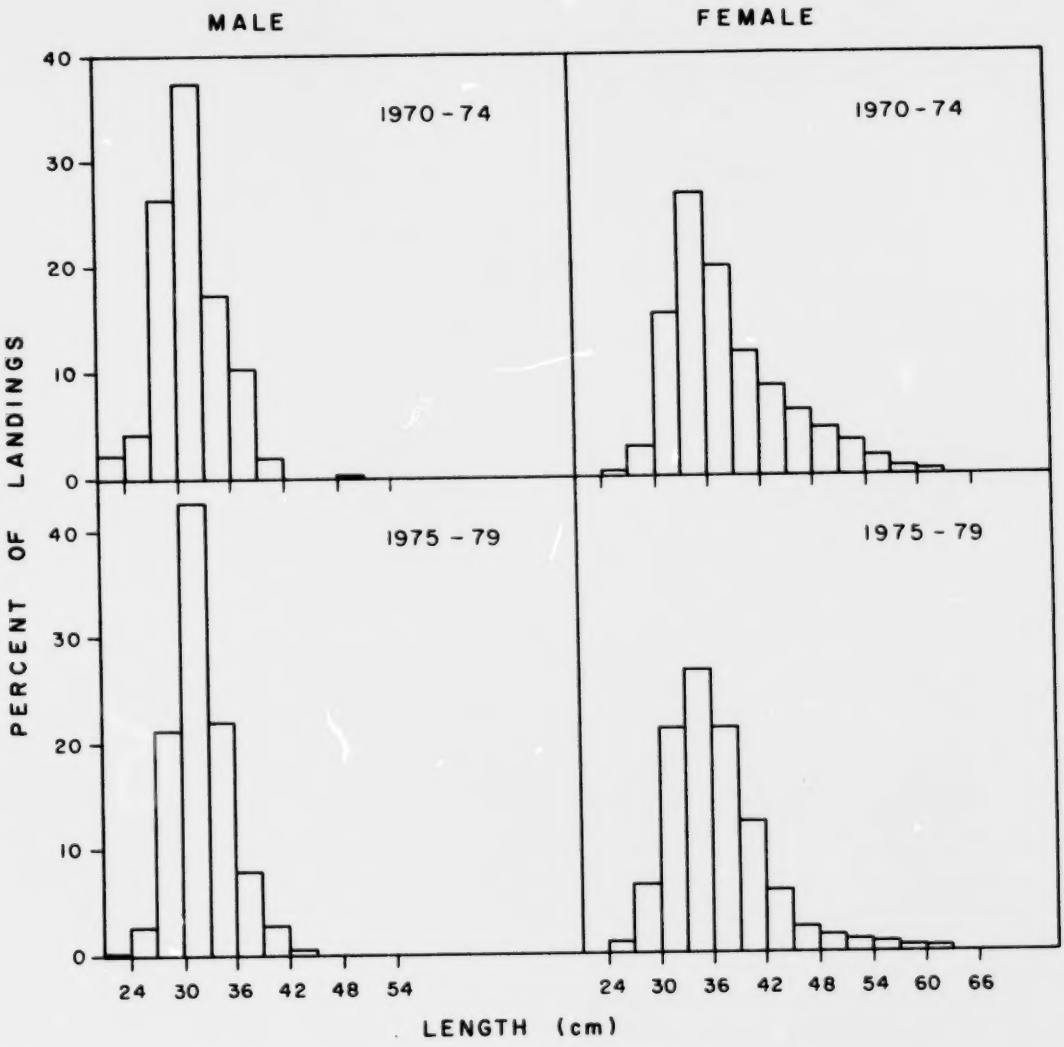

Fig. 16. Length frequencies of American plaice landed by Canadian Danish seiners in Div. 4T, 1970-79.

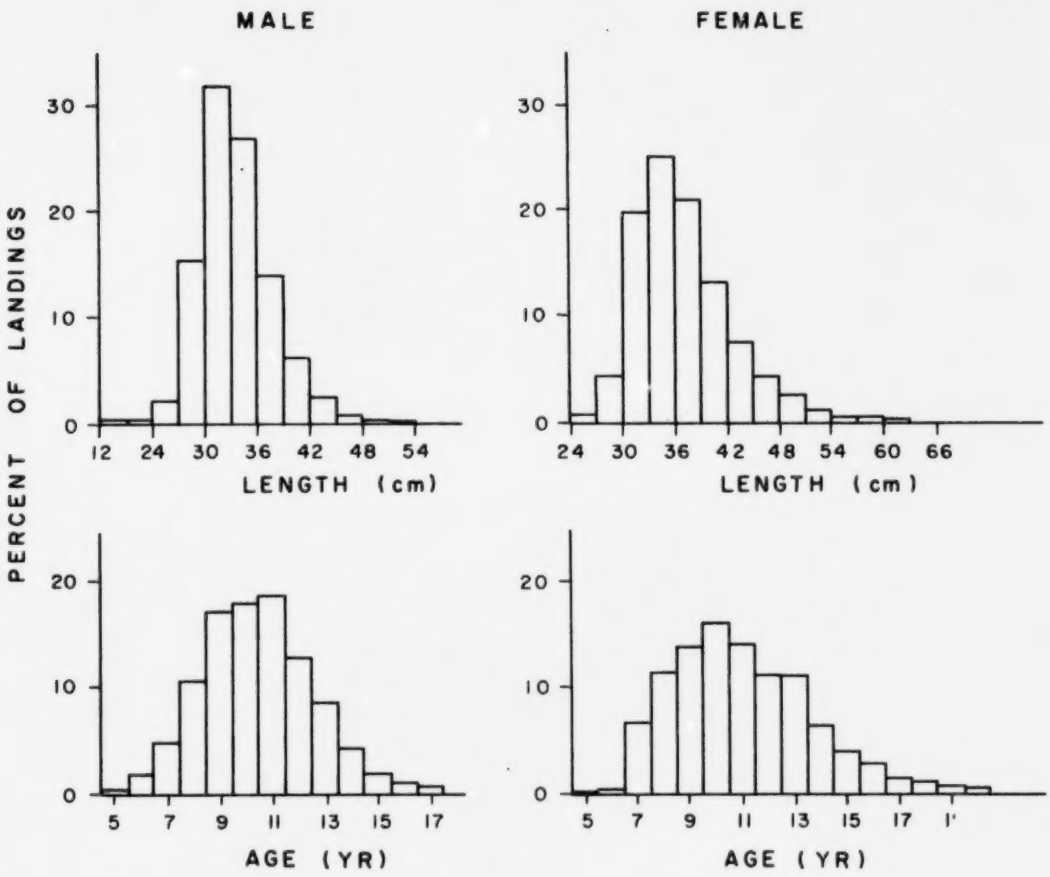

Fig. 17. Length frequencies and age compositions of American plaice landed by Canadian Danish seiners from Subdiv. 4Vn, 1975-79.

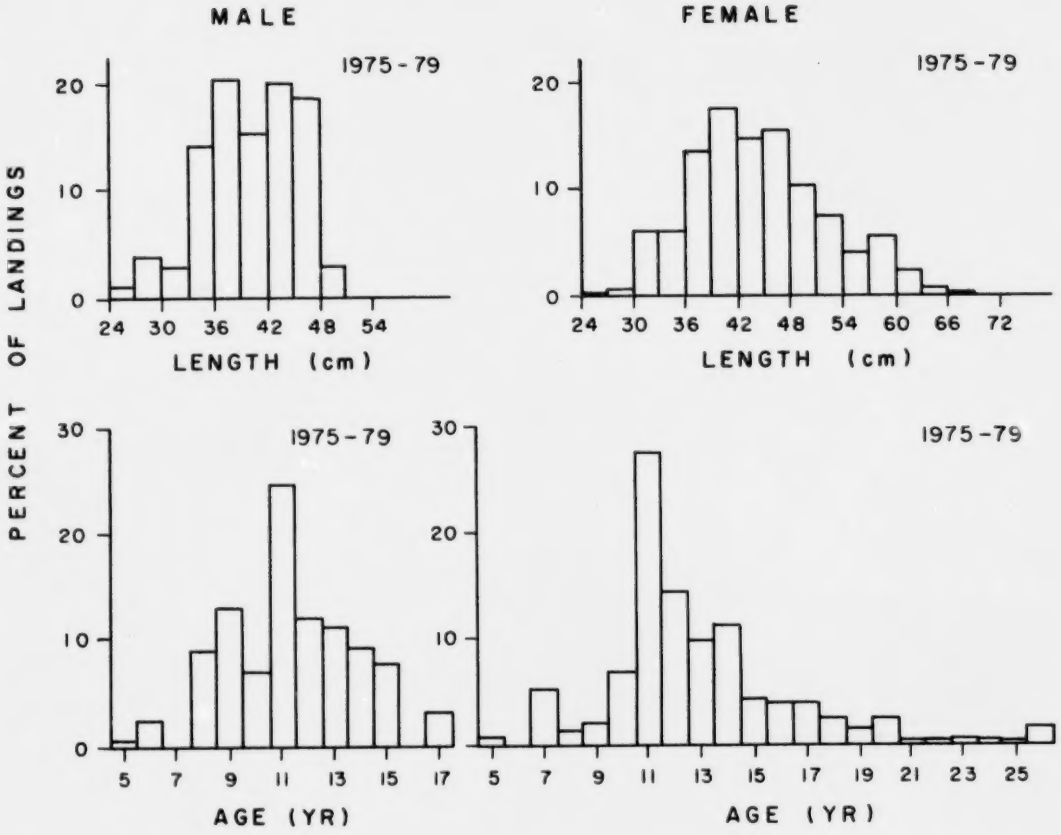

Fig. 18. Age compositions and length frequencies of American plaice landed by Canadian Danish seiners from Subdiv. 4Vs, 1975-79.

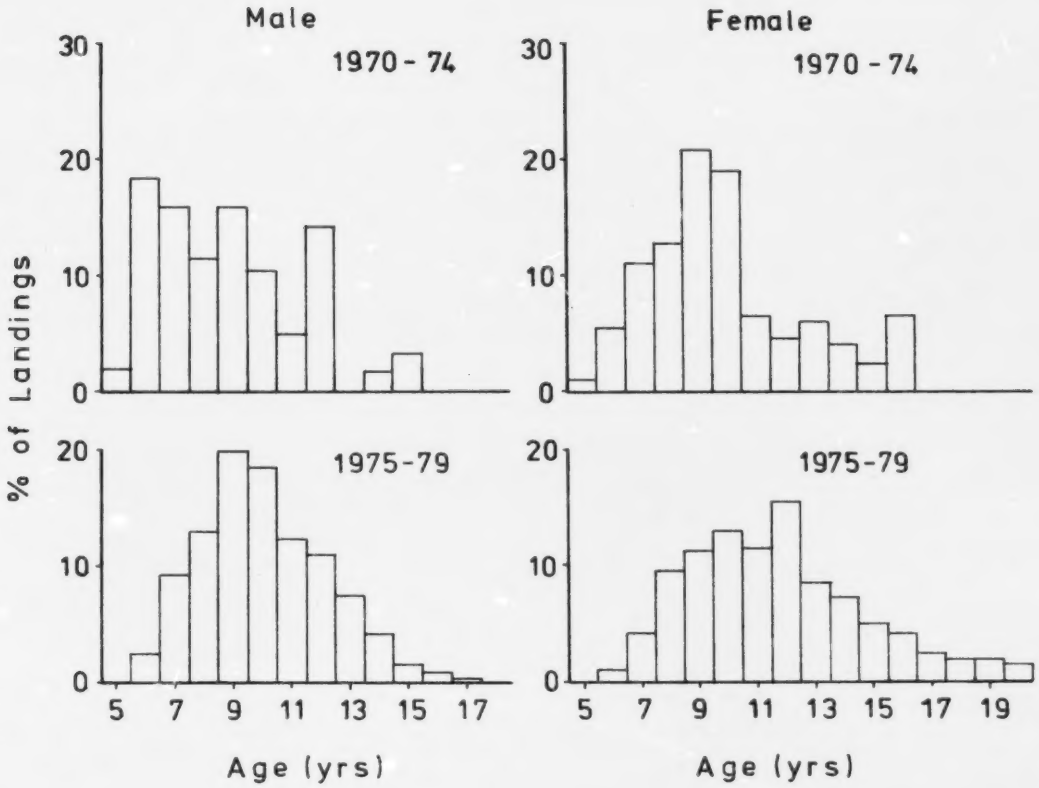

Fig. 19. Age compositions of American plaice landed by Canadian otter trawlers from Div. 4T, 1970-79.

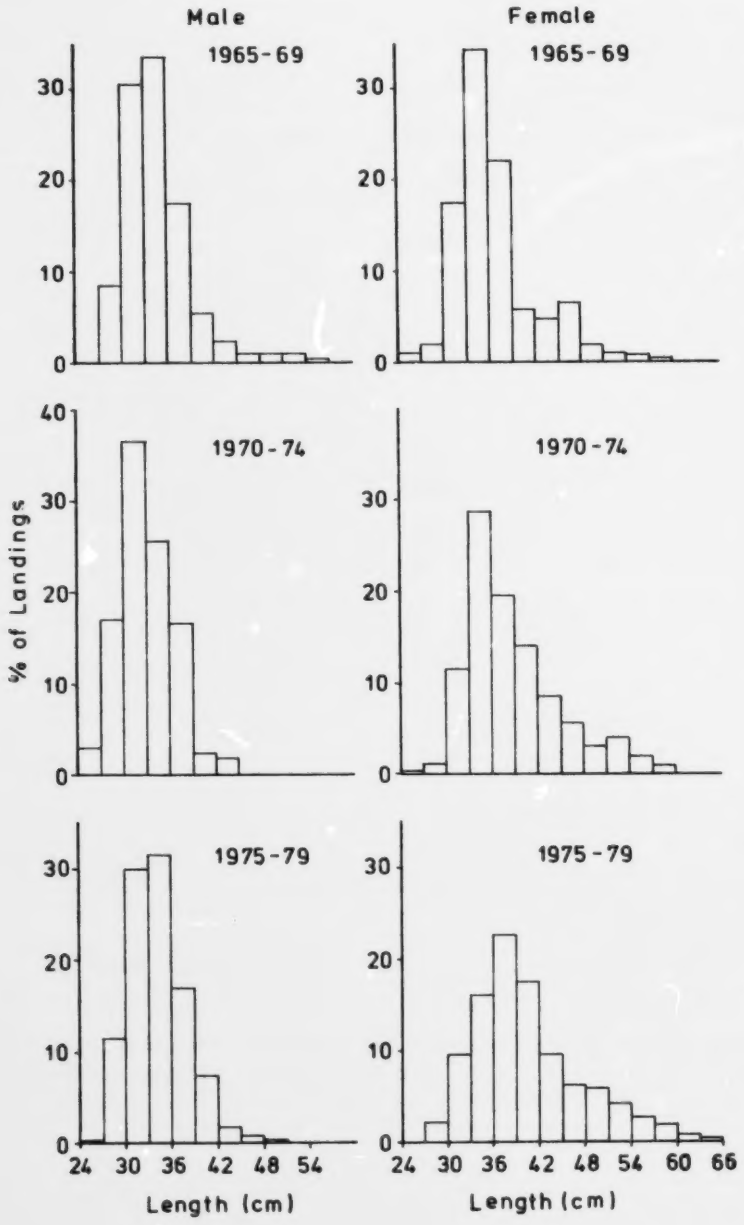

Fig. 20. Length frequencies of American plaice landed by Canadian otter trawlers in Div. 4T, 1965-79.

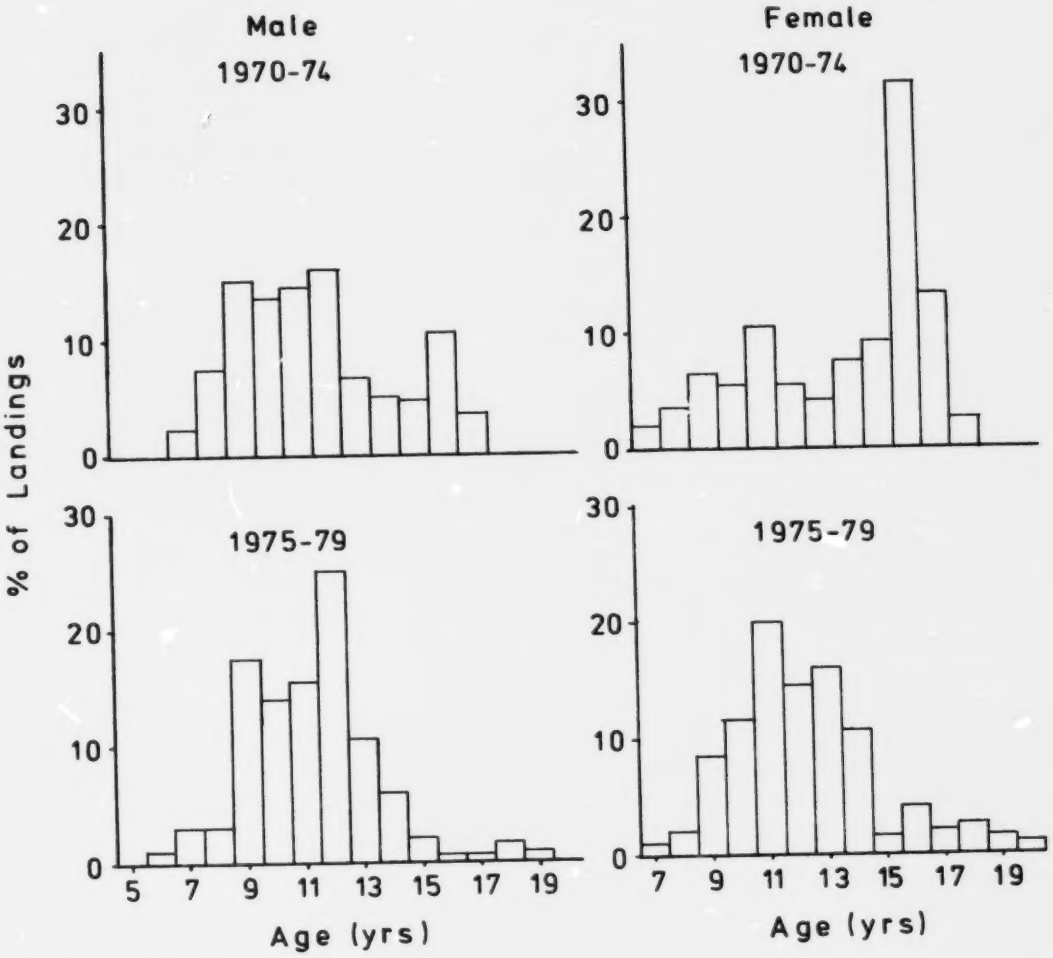

Fig. 21. Age compositions of American plaice landed by Canadian otter trawlers from Subdiv. 4Vn, 1970-79.

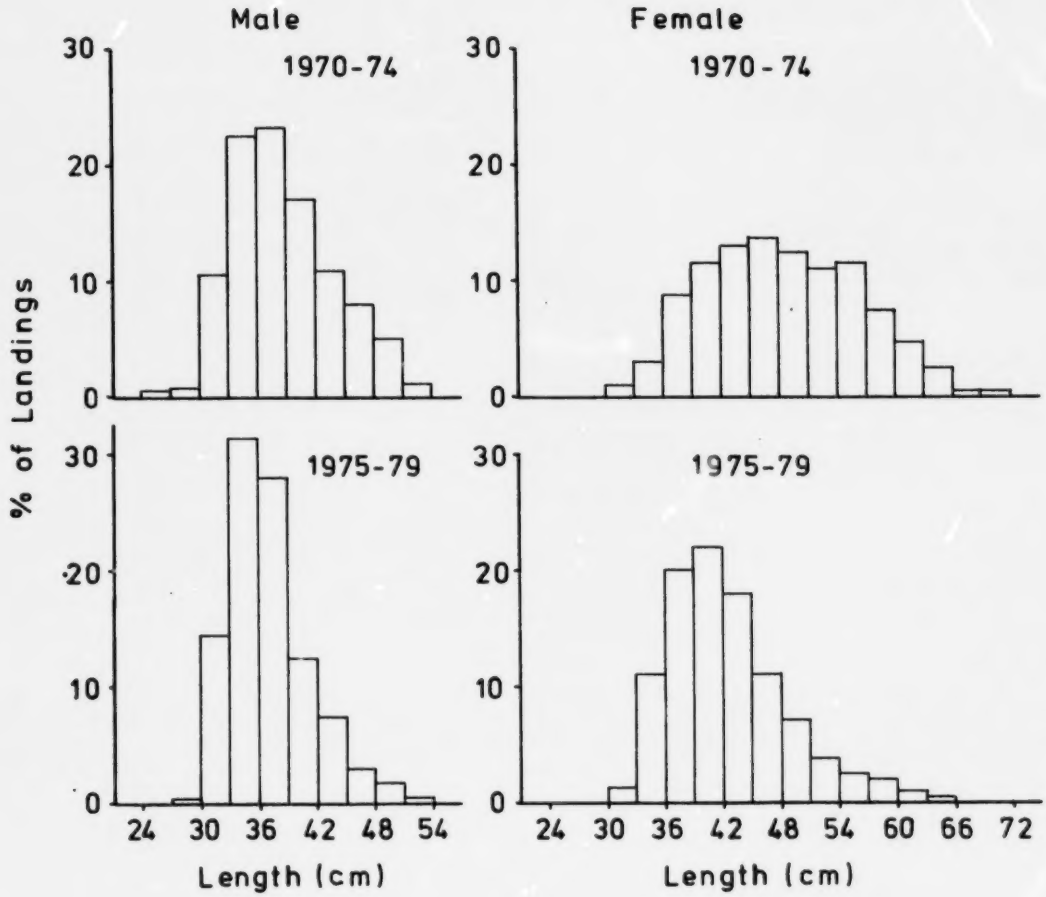

Fig. 22. Length frequencies of American plaice landed by Canadian otter trawlers in Subdiv. 4Vn, 1970-79.

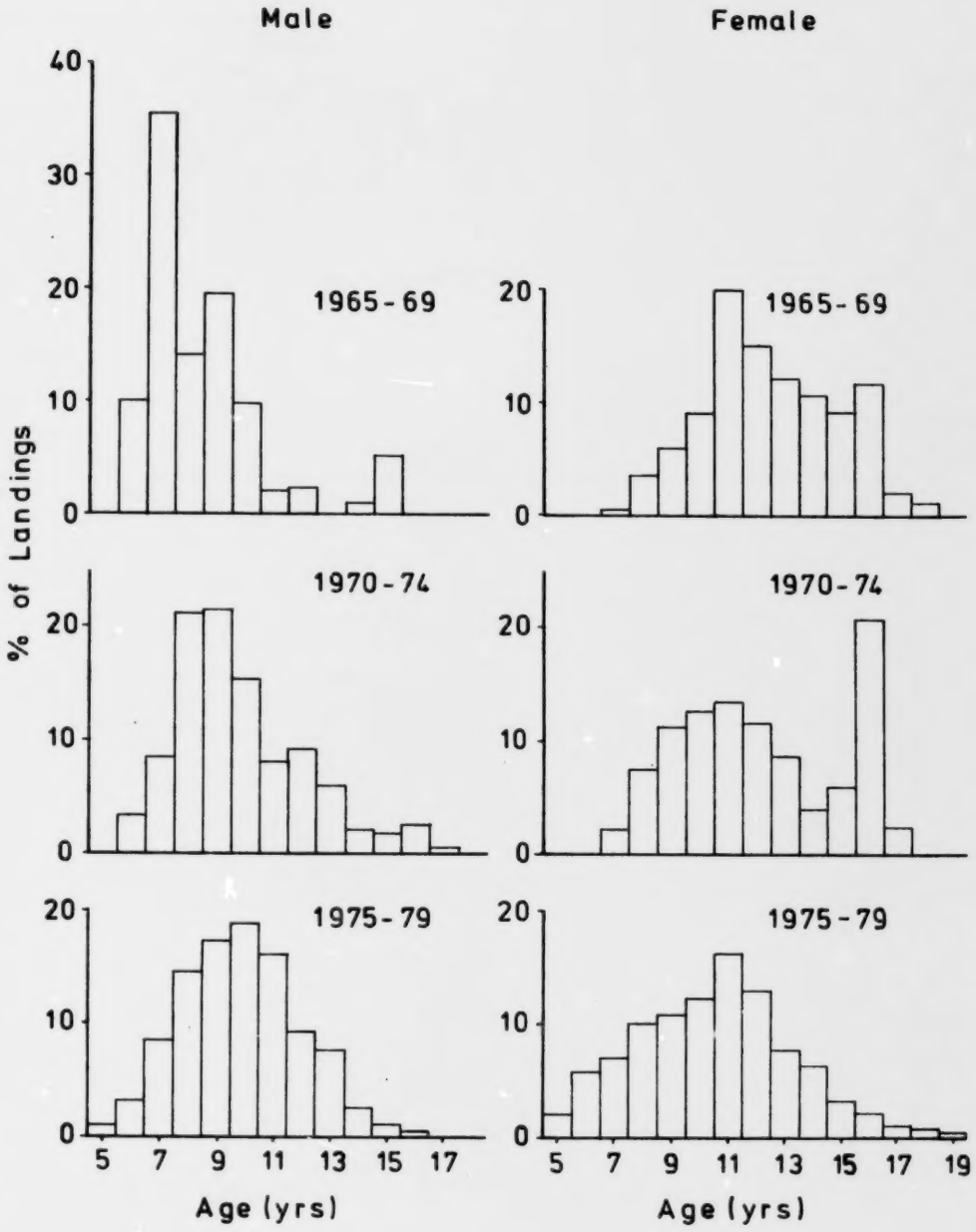

Fig. 23. Age compositions of American plaice landed by Canadian otter trawlers in Subdiv. 4Vs, 1965-79.

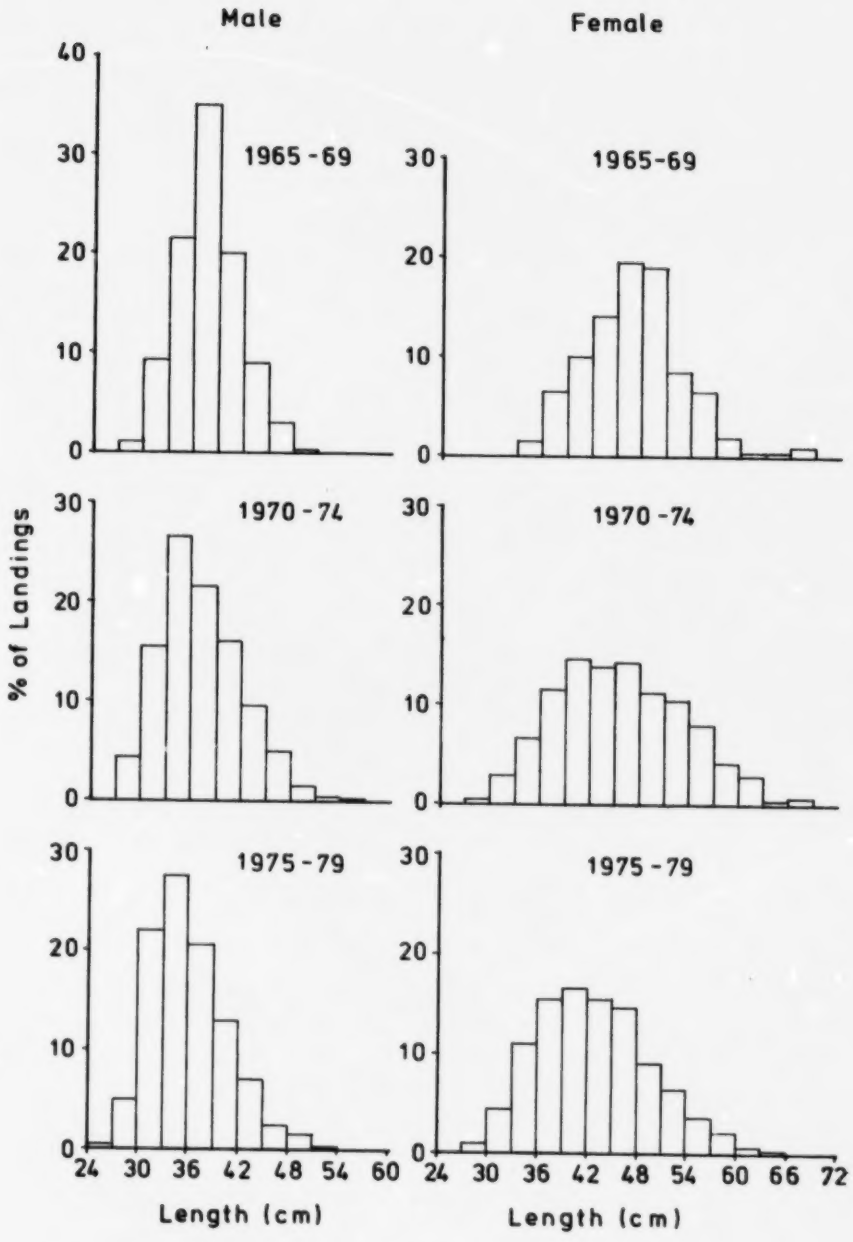

Fig. 24. Length frequencies of American plaice landed by Canadian otter trawlers in Subdiv. 4Vs, 1965-79.

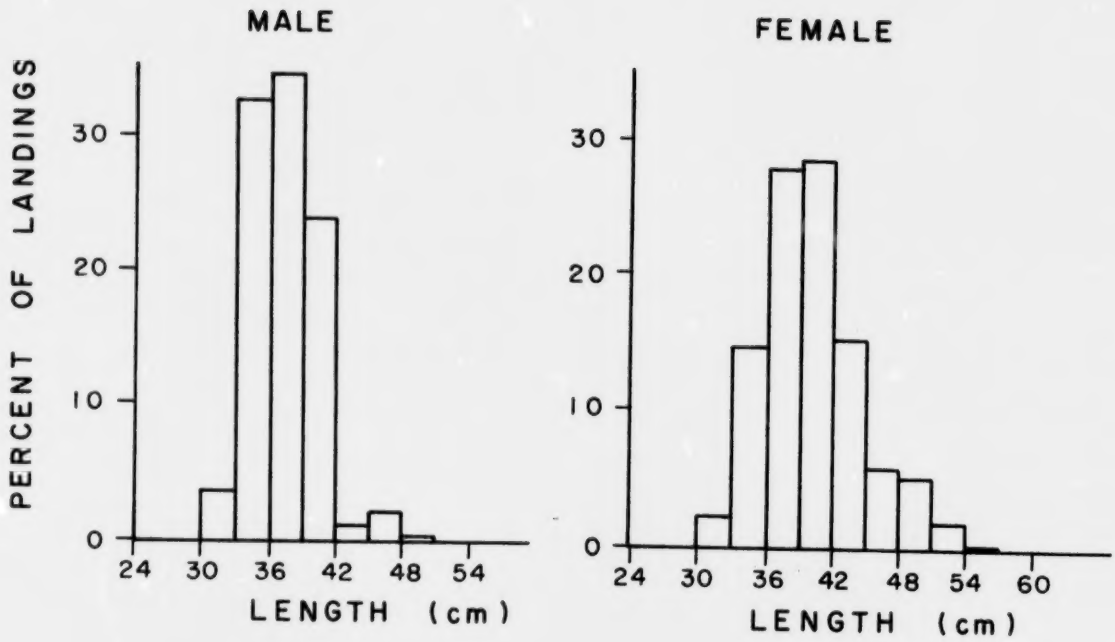

Fig. 25. Length frequencies of witch flounder landed by Canadian Danish seiners in Div. 4T, 1975-79.

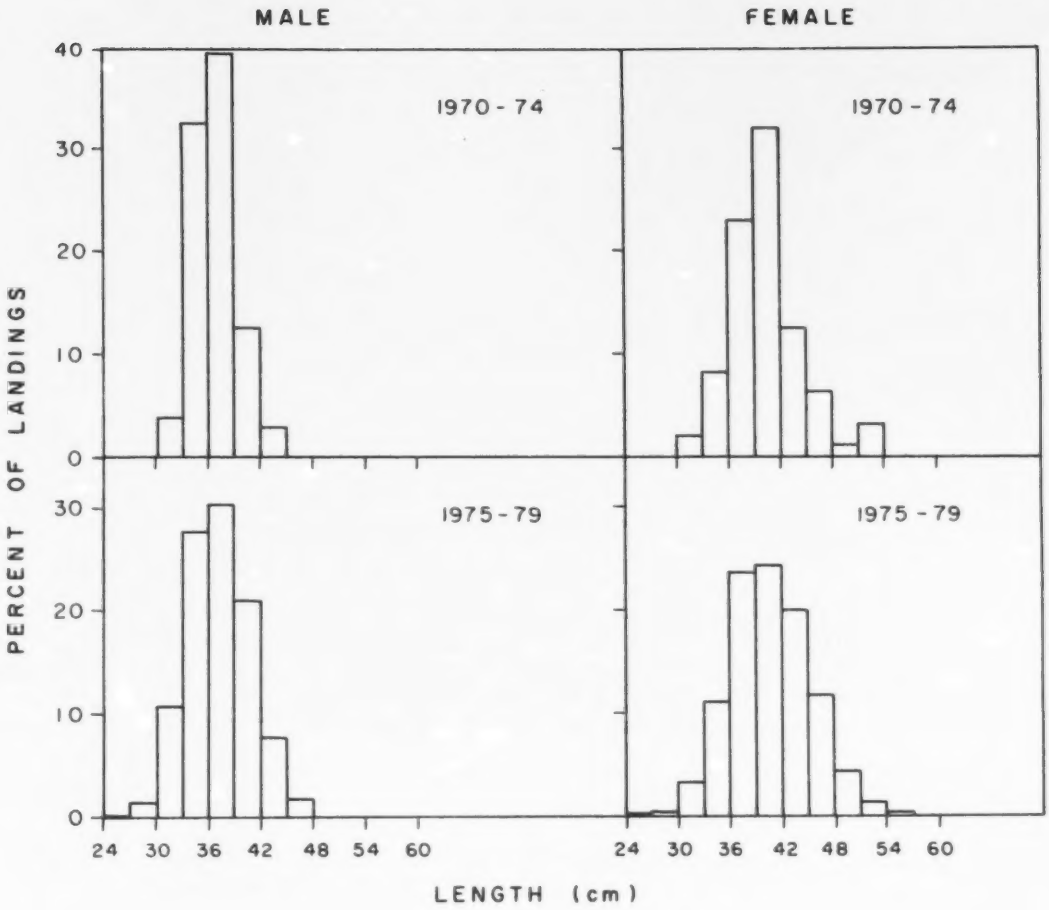

Fig. 26. Length frequencies of witch flounder landed by Canadian Danish seiners in Subdiv. 4Vn, 1970-79.

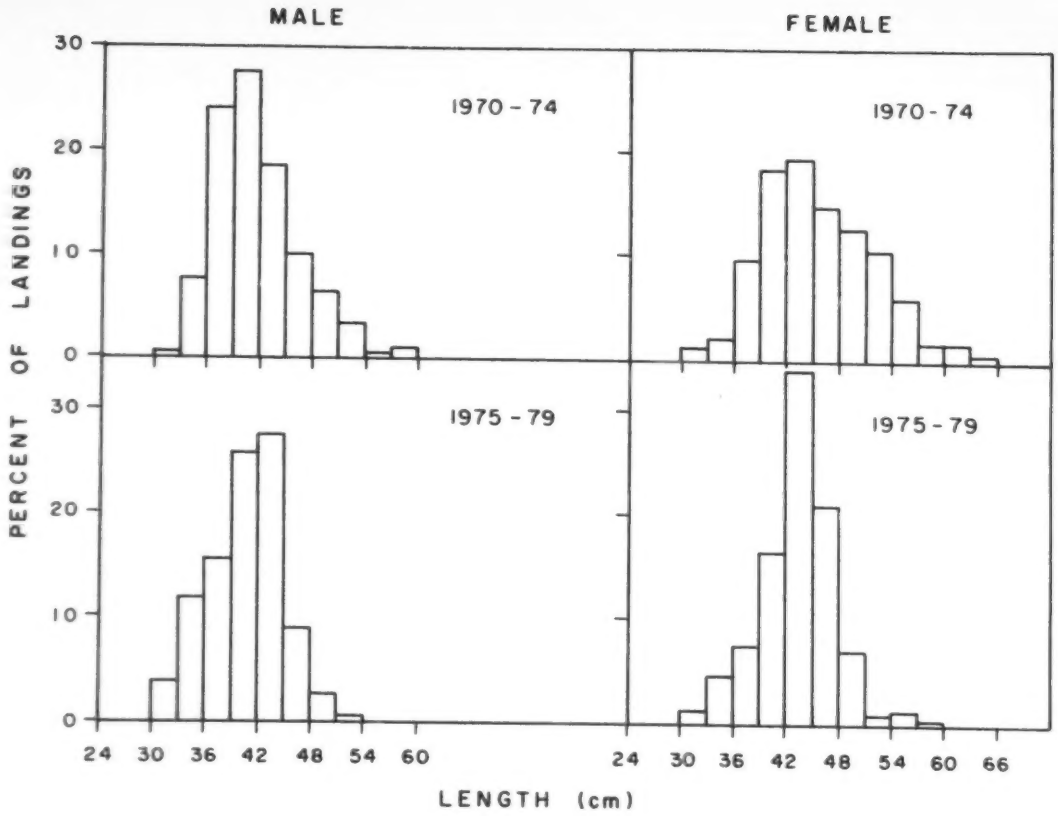

Fig. 27. Length frequencies of witch flounder landed by Canadian Danish seiners in Div. 4W.

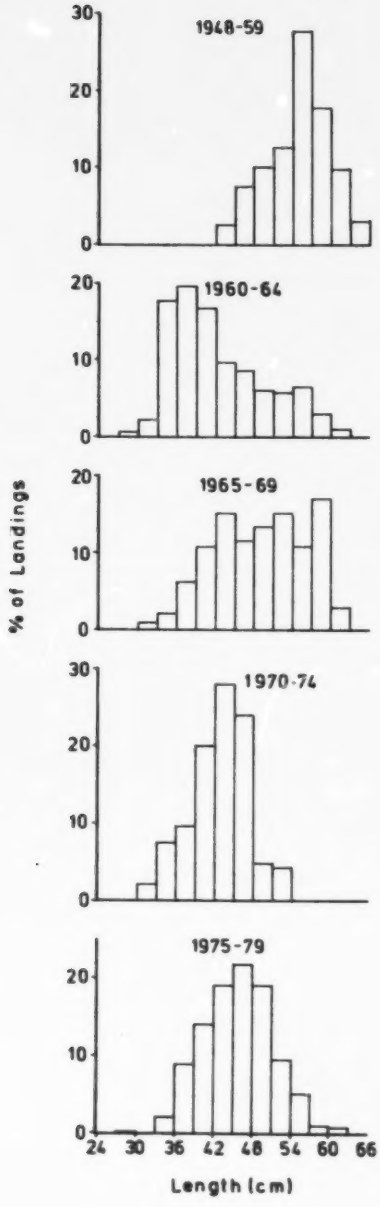

Fig. 28. Length frequencies of female witch flounder landed by Canadian otter trawlers in Div. 4T, 1948-79.

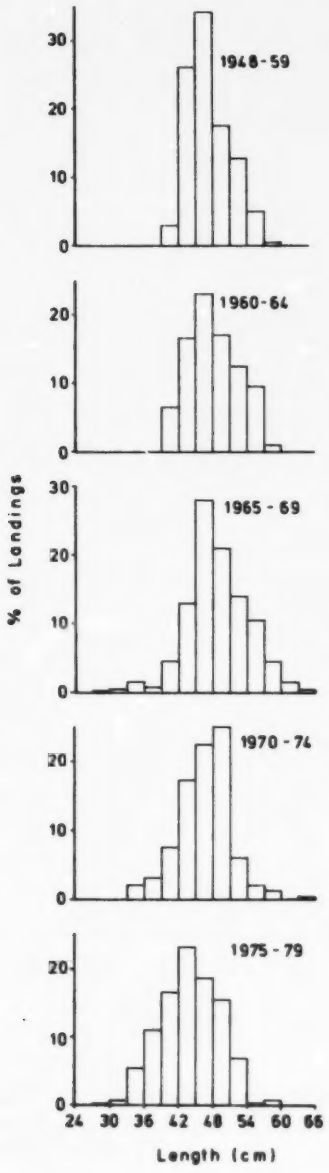

Fig. 29. Length frequencies of female witch flounder landed by Canadian otter trawlers in Subdiv. 4Vn, 1948-79.

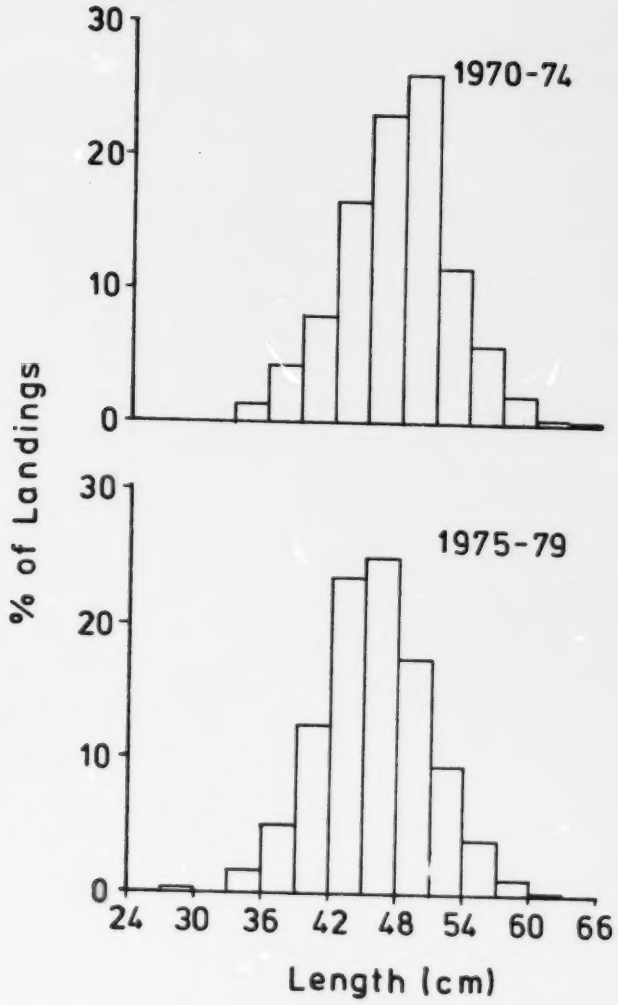

Fig.30. Length frequencies of female witch flounder landed by Canadian otter trawlers in Subdiv. 4Vs, 1970-79.

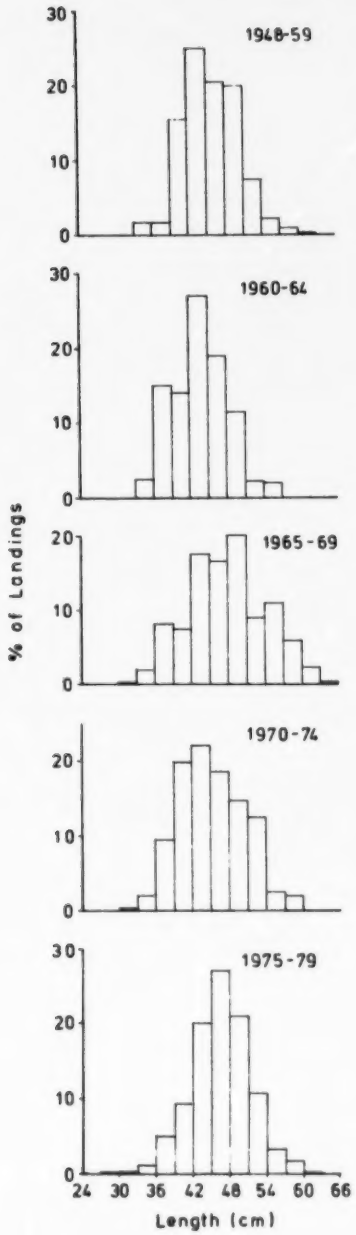

Fig. 31. Length frequencies of female witch flounder landed by Canadian otter trawlers in Div. 4W, 1948-79.